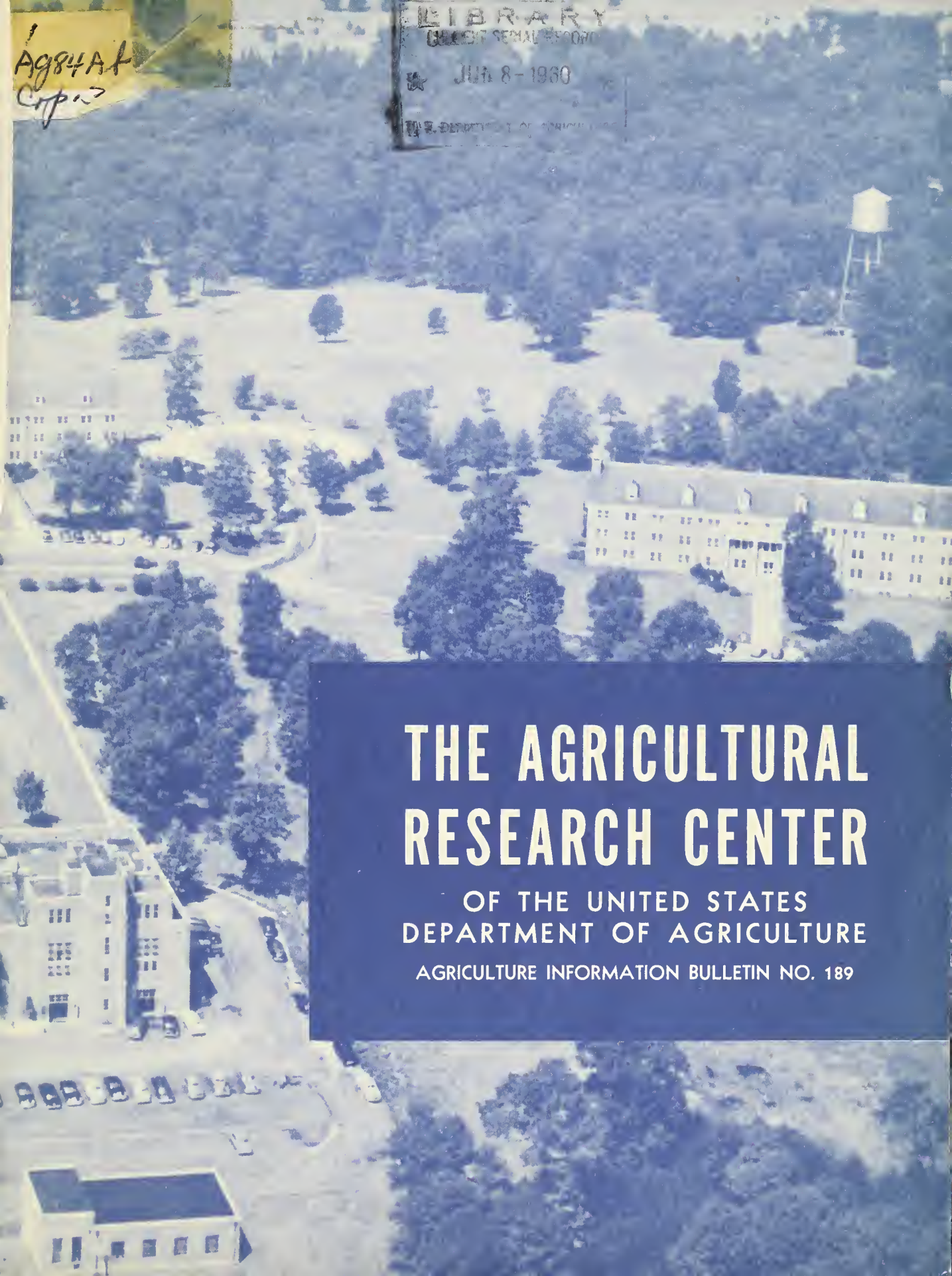


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THE AGRICULTURAL RESEARCH CENTER

OF THE UNITED STATES
DEPARTMENT OF AGRICULTURE

AGRICULTURE INFORMATION BULLETIN NO. 189

DIRECTORY FOR VISITORS

Visiting Hours: Monday through Friday, 8 a.m. to 4:30 p.m.; closed on Saturdays, Sundays, and holidays.

<i>Representative</i>	<i>Building</i>	<i>Room</i>	<i>Telephone</i>	<i>Extension</i>	<i>Agency Represented</i>
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UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D.C.

Lewis P. McCann (Chairman for group visits to Beltsville).	Administration Building.	536	DUDley 8-3697..	Foreign Research and Technical Programs Division, Agricultural Research Service.
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AGRICULTURAL RESEARCH CENTER, BELTSVILLE, MD.

C. A. Logan (Superintendent, Agricultural Research Center Operations).	Center Laboratory Building (3-307). ¹	121	GRanite 4-4800 ..	412	Operations and Management.
V. L. Simmons (Coordinator of domestic and foreign visitors at the Agricultural Research Center).	Center Laboratory Building (3-307).	121	GRanite 4-4800 .	413	Fish and Wildlife Service of the Department of the Interior, Patuxent Wildlife Research Center. Forest Service. Soil Conservation Service: Cartographic Division. National Plant-Materials Center. Soil Survey.
H. P. Lanchester.....	Entomology Laboratory A (4-476).	100	GRanite 4-4800.	207	Agricultural Marketing Service: Grain Division. Marketing Research Division. Beekeeping. Entomology Research Division. Forest Insects. Plant Pest Control Division.
John H. Martin..... Clarence S. Slater E. C. Scott	Administration Building (AO-003), Plant Industry Station.	12	GRanite 4-6500 .	664	Agricultural Engineering Research Division. Crops Research Division. Soil and Water Conservation Research Division.
J. H. Book.....	Dairy Physiology Building (1-173).	103	GRanite 4-4800 .	222	Dairy Cattle Research Branch. Eastern Utilization Research and Development Division (cheese).
Mrs. Zelta F. Rodenwold.	Center Laboratory Building (3-307).	115	GRanite 4-4800.	398	Institute of Home Economics.
R. L. Davis.....	Animal Husbandry Administration Building (2-200).	219	GRanite 4-4800.	384	Animal Disease and Parasite Research Division. Animal Husbandry Research Division. Eastern Utilization Research and Development Division (meats).

¹ Numbers in parentheses refer to building directory on pages 22-23.

THE AGRICULTURAL RESEARCH CENTER

OF THE UNITED STATES
DEPARTMENT OF AGRICULTURE



Agriculture Information Bulletin No. 189

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

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THE AGRICULTURAL RESEARCH CENTER

What It Is

The Agricultural Research Center is a part of the Agricultural Research Service (ARS) of the U.S. Department of Agriculture. Most of the ARS research divisions do part of their work at the Center. These are the Agricultural Engineering, Animal Disease and Parasite, Animal Husbandry, Clothing and Housing, Crops, Eastern Utilization Research and Development, Entomology, Human Nutrition, and Soil and Water Conservation Research Divisions, and the regulatory division of Plant Pest Control. Other Department of Agriculture agencies that carry on research at the Center are the Agricultural Marketing Service, Forest Service, and Soil Conservation Service.

A few other units of the United States Government conduct research at the Center. They are radio station WWV of the National Bureau of Standards of the Department of Commerce, the Mineral Deposits and the Geochemistry and Petrology Branches of the Geological Survey of the Department of the Interior, and the Veterinary Branch Therapeutic Testing Laboratory of the Food and Drug Administration of the Department of Health, Education, and Welfare. Adjoining the Center is the Patuxent Research Center, where the Fish and Wildlife Service of the Department of the Interior studies wildlife problems that relate to agriculture.

Agricultural research at the Center deals mainly with broad problems of national interest. Much of it is basic, or fundamental, research. Its aim is to accumulate scientific information that can be applied elsewhere. Often two or more divisions work together, combining the talents and experience of several groups of ARS scientists. Many of the projects are carried on in cooperation

with one or more State agricultural experiment stations. This cooperative research has led to countless discoveries that have contributed greatly to bringing American agriculture to its present high level.

When thoroughly proved, results of all research work done in cooperation with the Department are made public through the Department's Office of Information in Washington, D.C.

The Agricultural Research Center covers about 11,000 acres (1 hectare equals 2.471 acres). The land is divided into experimental pastures, ranges, orchards, gardens, fields for cultivated crops, timber stands, and soil-treatment plots. The Center has 968 buildings that are equipped to meet the needs of special kinds of research and to provide office and laboratory space for approximately 2,750 employees. About half of these employees are scientists or technicians; the others are clerical, farm, and maintenance workers. Those doing research include agronomists, animal husbandmen, apiculturists, architects, bacteriologists, biochemists, biologists, botanists, chemists, dairy technologists, engineers, entomologists, geneticists, grain technologists, helminthologists, home economists, horticulturists, mycologists, nematologists, nutritionists, olericulturists, parasitologists, pathologists, physicists, physiologists, statisticians, veterinarians, and zoologists.

Among the Center's buildings are 63 laboratories, 31 greenhouses, 180 barns and storage buildings, 694 small-animal and poultry houses, shops, an apiary, a granary, a warehouse, and heating, water-treatment, and sewage-disposal plants.

The Center has nearly 3,000 experimental farm animals, more than 10,000 laying and breeding fowls, and about 5,500 small animals that are used in lab-

oratory tests. Most of the dairy herd of 500 cattle are Holsteins or Jerseys.

Where It Is

The Agricultural Research Center is near Beltsville, Md., 15 miles northeast of Washington, D.C. It occupies two separate tracts on opposite sides of the Washington-Baltimore Boulevard, U.S. Route No. 1. On the northwest side of the highway, 2½ miles northeast of the University of Maryland, is the Plant Industry Station, headquarters of Agricultural Engineering, Crops, Entomology, and Soil and Water Conservation Research Divisions. About a mile northeast of the Plant Industry Station, on the east side of the highway, is the entrance to the larger tract, site of the other activities of the Center. The Baltimore-Washington Parkway passes through the Center east of the Center Laboratory Building. Access roads lead off at Powder Mill Road. The map on pages 22-23 shows the boundaries of the Center, highways and access roads, and location of the buildings.

How To Get There

The best way for an individual or a small group to visit the Center is by automobile, because many of the buildings are some distance from public transportation. Large groups frequently charter a bus. When this is done, ARS will supply a guide to describe the activities of the Center during regularly scheduled workdays, Monday through Friday, from 8 a.m. to 4:30 p.m. Buildings, laboratories, and barns are closed to the public on Saturdays, Sundays, and holidays.

The Center may also be reached by Greyhound buses, which stop on U.S. Route 1 at the Plant Industry Station and at Beltsville. Two special Greyhound buses leave the terminal at 12th

Street and New York Avenue NW. in Washington at 7 a.m., Monday through Friday, arriving at the office of the Superintendent of the Center at 7:55 a.m. This office is 2 miles from the regular bus stop at Beltsville.

Visitors Welcome

Persons interested in research to improve farming and farm living are always welcome at the Center, where a small staff is available to explain the

work. In fiscal 1959 about 15,000 persons visited the Center. They came from all the States and Puerto Rico and 91 foreign countries.

Visitors who wish to consult scientists at the Center should make appointments through the designated representatives listed inside the front cover of this publication. Visitors who wish to see the Animal Disease Station where studies of infectious diseases and disease con-

trol are in progress, must also make appointments.

Two cafeterias at the Center serve luncheon. Advance luncheon arrangements are necessary when large groups are to be served.

This publication is intended as a general guide. A directory for visitors is inside the front cover. Brief descriptions of the work done at the Center follow.

AGRICULTURAL RESEARCH SERVICE

Agricultural Engineering Research Division

The Agricultural Engineering Research Division, which has headquarters at the Plant Industry Station, conducts most of its research in cooperation with State agricultural experiment stations at other locations. However, some of the research on farm buildings, farm electrification, and farm machinery is carried on at the Agricultural Research Center.

Farm Housing

Five expansible houses have been built at the Center. Relatively new materials were used, including lightweight concrete blocks, special large bricks, and asbestos-cement and aluminum sheets for exterior walls and aluminum, plywood, and plastic sheets and fiberboards for interior finishes. Different types of

heating equipment, including a heat pump for heating and cooling, have been installed in the houses. Temperature, humidity, and radiation studies are being made and data obtained on moisture movements under concrete floor slabs on the ground.

The houses are occupied by workers from the Center dairy farm. Information on their livability is being obtained



N-13458

Split-level, expansible house with special large bricks for walls, plank-and-beam roof covered with corrugated aluminum, and a warm-air, perimeter-type heating system.

in cooperation with the Clothing and Housing Research Division, which helped to adapt the house plans to farm-family requirements.

Plans of Farm Buildings

The Cooperative Farm Building Plan Exchange, with offices at the Plant Industry Station, develops plans for improving farm buildings in cooperation with committees representing the State agricultural colleges of the northeastern, southern, and western regions. The plans are made available to farmers through the State extension services.

Making and Storing Hay and Silage

Investigations on forage harvesting and farm machinery and equipment have contributed to fundamental information on methods of making hay and silage. The Division uses standard experimental harvesting equipment in cooperation with farm-machinery manufacturers and dairy-nutrition specialists of the Animal Husbandry Research Division. Studies have been made on barn drying, dehydration of hay, and methods of making high-quality silage.

Agricultural engineers are working with dairy and other specialists on different methods and types of structures

for storing and self-feeding silage. They have built two aboveground horizontal silos to determine structural requirements and to solve problems of excess juice drainage. They are seeking ways to protect and rehabilitate walls of tower silos.

Effects of Light and Temperature on Poultry

Research is conducted on the use of light and radiation on chickens and turkeys to determine the effects of quality and intensity of light and length of day on egg production and fertility. With turkeys one of the problems has been to maintain egg production throughout the year. Poultry specialists and engineers determine physiological responses of poultry to visible, ultraviolet, infrared, and other radiations.

In a cooperative study they are using two respiration calorimeters to determine the effects of temperature, relative humidity, floor space, and other housing conditions on the growth, egg production, and feed consumption of chickens. Any desired temperature can be maintained, from below freezing to over 100° F. Equipment measures the heat, moisture, carbon dioxide, and ammonia given off by growing chicks and

laying hens. Such data aid in the design of poultry houses.

Electrical Equipment for Livestock Farming

Equipment for year-round air conditioning is tested to determine the controls required, problems of usage, electrical loads, and performance in heating and cooling of livestock facilities. Heat pumps (reverse-cycle refrigeration) provide both heating and cooling automatically. Methods of air conditioning are developed to meet livestock-ventilation requirements.

In cooperation with engineering specialists in building design and arrangement, research is being conducted on livestock management practices and performance of electrical equipment in use in livestock production. Electrically controlled and powered equipment is developed to reduce labor in livestock production. Performance requirements and characteristics of such equipment are determined in relation to automatic control and elimination of manual labor and supervision.

Portable electric fence posts and fence components used in rotation grazing are being tested by engineers and dairy specialists. Emphasis in this work is on obtaining dependable control of cattle



Portable electric fences for rotation grazing.

PN-586

by electric-fence systems in all types of weather.

Methods and equipment to provide standby electric power when local service is disrupted have been studied. Although such standby service may be used only a few hours per year, the performance required is rather exacting. Most farm-wiring systems and equipment require a current with the following characteristics: Dual voltage, 3 wires, 115 to 230 volts, single phase, and 60 cycles. The generator may be powered by an integral engine or farm tractor.

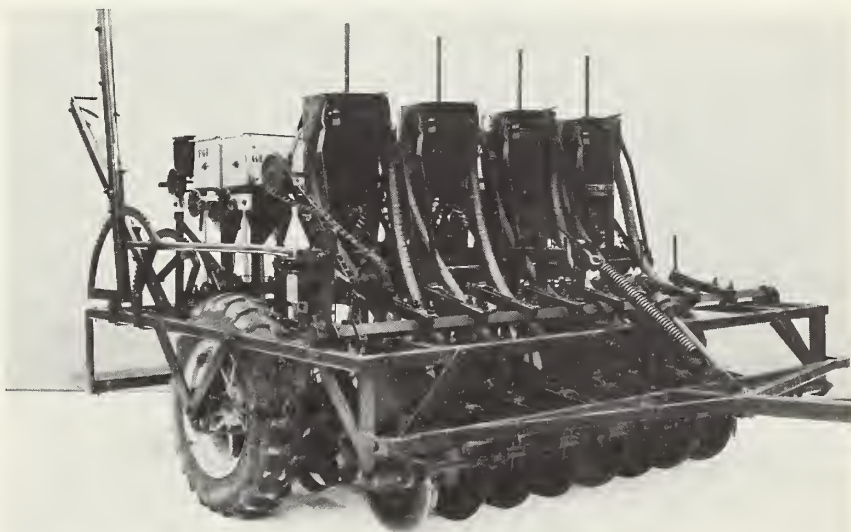
Improving Planting and Fertilizing Machinery

At the Agricultural Engineering Laboratory engineers design and build special planting and fertilizing machines and equipment. The planting machines include seeders and planters; the fertilizing equipment includes attachments to side dressers and to subsoiling machines, which can apply both dry and liquid fertilizers. This laboratory conducts field experiments in cooperation with other ARS units and State agricultural experiment stations. The most efficient methods of planting and fertilizing are determined for various crops in different regions. More than 40 field

and vegetable crops have been studied. The data reported from cooperative studies with more than half the States participating since about 1925 have helped industry to provide better farm machinery.

Current studies include pasture-establishment methods, application of fertilizer solutions, drillability of ferti-

lizer, subsoiling with deep placement of fertilizers, vegetable crops on mineral or organic (muck) soils, grains, and special crops such as canaigre—a root crop for tannic acid. The work, which has headquarters at the Center, has been expanded and is being carried on at two stations in the southeast and southwest regions.



F-3074

Drill designed for grassland-establishment experiments on prepared seedbeds or for plot work with grains. Fertilizer and seed may be broadcast and drilled or planted at different depths and spacings.

Animal Disease and Parasite Research Division

The function of this Division is to conduct a closely coordinated, fundamental, and applied research program directed primarily toward developing measures and techniques for the prevention, control, and eradication of communicable diseases and parasites of domestic animals, poultry, and fur-bearing animals raised in captivity.

Livestock Diseases Attacked by Science

The Animal Disease Station utilizes approximately 350 acres, about 100 acres of which is planted to feed crops for the experimental animals. It has 200 structures, including laboratories, small-animal breeding facilities, experimental isolation barns, pens and pastures, 1 central incinerator, several auxiliary in-

cinerators, and 3 sewage-decontamination units. About 600 large experimental animals—horses, cattle, sheep, goats, and swine—and approximately 2,000 poultry are maintained. Small animals such as guinea pigs, mice, and rabbits are raised to supply the needs of the Station.

Brucellosis, or Bang's disease, of cattle has received major attention for several years. Workers at this Station first made antibrucellosis vaccine (*Brucella abortus*, strain 19), now widely used throughout the world. Studies have shown that existing drugs, chemicals, and biologicals are not an effective, practical cure for this disease; however, vaccination of calves has proved to be an effective preventive. Anaplasmosis and mastitis of cattle and sterility

of cattle resulting from *Vibrio fetus* infection also receive major attention.

Other diseases under study are erysipelas of swine; vesicular stomatitis of cattle, swine, and horses; vesicular exanthema of swine; and fowl typhoid and Newcastle disease of poultry. Research on vesicular diseases that resemble foot-and-mouth disease has provided information that aids in a prompt, accurate diagnosis when foot-and-mouth disease is suspected.

All diagnostic antigen used in the Federal-State program for the control of brucellosis is prepared at the Station.

Strategy Against Livestock Parasites

Investigations of animal parasites include studies of external and internal



N-16769

Preparing for study parasite tissue and host tissue injured by parasites.

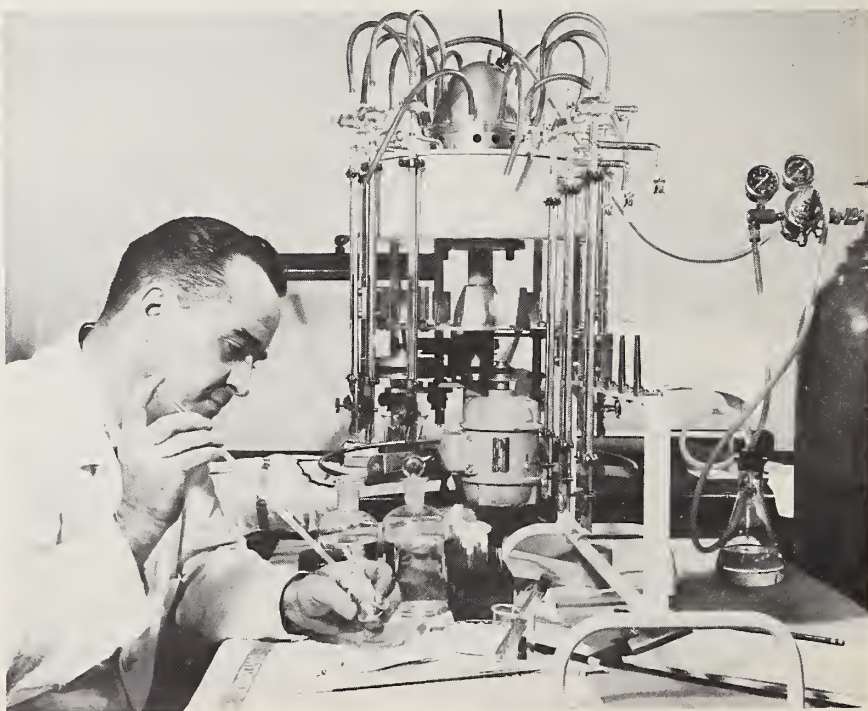
pests of farm animals and poultry from the standpoints of (1) identity and structure of the organisms, (2) their geographic distribution in the United States and elsewhere in the world, (3) life cycles and modes of transmission, (4) injurious effects produced and the defense mechanisms developed by infected animals to confine the injuries, (5) treatment of infected animals with curative and preventive drugs and chemicals, and (6) prevention of parasite spread through management practices.

Approximately 200 acres is devoted to animal-parasite investigations. A part of this area is divided into about 74 plots, ranging from one-fourth acre or smaller to 5 acres, which are used as pastures or for small-scale field experiments. About 500 large animals, including cattle, sheep, goats, and swine, and about 1,200 chickens and turkeys are used for experimental purposes during a year. Facilities include a sizable laboratory building, in which the parasite collection and the Index-Catalogue of Medical and Veterinary Zoology are

housed, 2 smaller laboratory buildings, 4 other buildings used for research, 75 miscellaneous buildings, barns, and shelters for the animals, and an incinerator.

Here parasitologists, veterinarians, zoologists, and technicians study the vast number of parasites that attack livestock and poultry and develop treatments and control measures to protect domestic animals and birds from parasites. Part of the strategy in waging war on these pests is to determine the most vulnerable points in their life cycles and then develop measures to break the cycle and thereby circumvent their attacks on animals and birds.

The research has developed important medicinal treatments that have become standard practice throughout most of the world. Treatments with phenothiazine for removing injurious worms that infest horses, cattle, sheep, goats, swine, and poultry have been developed at the Center, as well as treatments with sodium fluoride for removing roundworms from swine and treatments with lead arsenate for removing tapeworms from sheep. This research



N-16770

Using a modern precision instrument to study the physiology of microscopic parasites, some of which cause reproductive failures in cattle.



Obtaining identified specimens of animal parasites from the collection housed at the Center.

has led to improved methods of using drugs for the prevention and control of coccidiosis and worm parasites in chickens and turkeys. Moreover, much of the important knowledge on trichinae in swine, tapeworm cysts in beef, and other parasites of farm animals transmissible to man has stemmed from the research at the Center on livestock parasites. The precise nature of the in-

juries produced by certain parasites of cattle, sheep, and swine and much of the basic information on the biology of these parasites have been brought to light during these studies.

A unique feature of the parasite research at the Center is the work on the Index-Catalogue of Medical and Veterinary Zoology. This publication has attracted worldwide attention and has

contributed a great deal to a better understanding of parasitism as a world problem in relation to livestock production and human health. The collection of parasites at the Center, probably the largest of its kind to be found anywhere, facilitates the identification of parasites, because it affords a comparison of forms already identified with those under investigation. The parasite collection and

Index-Catalogue are of immense value in formulating control programs that are aimed at preventing exotic pests from entering the United States.

These and many other activities underway at the Center have helped to make livestock and poultry raising safer and more profitable. Sometimes the results of research show how a combination of methods can best be used. For example, the research workers

found that larvae of the stomach and nodular worms and other injurious internal parasites of sheep did not survive more than 4 months under pasture conditions. This finding formed the basis of a control program that included treatment of the breeding flock with phenothiazine late in the fall and early in the spring and then placing the sheep on pasture that had been allowed to lie idle over the winter. Other studies showed

that pigs infected with kidney worms did not pollute their quarters and pastures with the parasite eggs until the worms had existed in them for many months. This finding has suggested a possible way of reducing, and perhaps even eradicating, these pests by using only young sows, 'presumably still uninfected, for pig production. This control method is now being tested in the field.

Animal Husbandry Research Division

The headquarters of the Animal Husbandry Research Division and one of the Division's major field stations are located at the Agricultural Research Center. Extensive research studies are under way there to develop new and improved methods of livestock production, including more efficient breeding, feeding, and management of beef, dual-purpose, and dairy cattle, poultry, sheep, goats, and swine, and processing and preserving their products. The Nation's rapidly growing population emphasizes the need for more intensive livestock production, while at the same time current economic conditions stress the need for greater efficiency in farm- and livestock-production practices. Improved methods of animal breeding, feeding, and management are necessary to meet many current and prospective needs for food and clothing, while at the same time livestock production is

being made more remunerative to the livestock producer.

Beef Cattle Research Branch

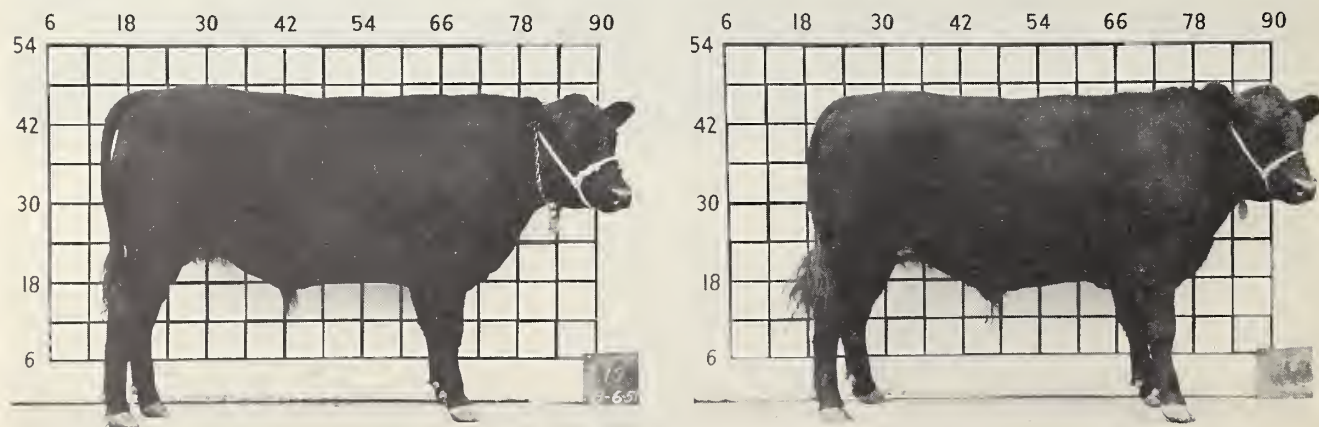
This Branch carries on research in breeding, nutrition, physiology, and management of beef and dual-purpose cattle.

At the Center, the research studies emphasize beef cattle nutrition and physiology. Most of the Department's beef cattle breeding and management research is done at six federally owned field stations in Montana, Nebraska, Oklahoma, Louisiana, Virginia, and Florida and in cooperation with 35 State agricultural experiment stations. One State experiment station is cooperating on dual-purpose cattle breeding research.

Studies at the Center on ruminant bloat have provided much basic information on possible causes of both pasture and feed-lot bloat, but no reliable

preventive measures are yet known. Legume bloat appears to be more complex than feed-lot bloat, as soil factors, plant constituents, and the ruminal microflora are probably involved in a sequence of biochemical events.

When animals were placed on a feed-lot type diet, slime-producing bacteria increased when the animals bloated. The slime produced by ruminal bacteria may alter the viscosity of the rumen fluid and thus cause an entrapment of the fermentation bases in a stable foam. The foam blocks the animal's normal belching mechanism and the animal becomes bloated. Other types of bacteria are probably involved. Recent studies on feed-lot bloat indicate that the incidence of bloat in steers is affected by the feeding schedule. Steers that received their daily ration in two feedings showed more bloat than those that have feed constantly available. Results from 1959 experiments indicate



Steer A

BN-5787

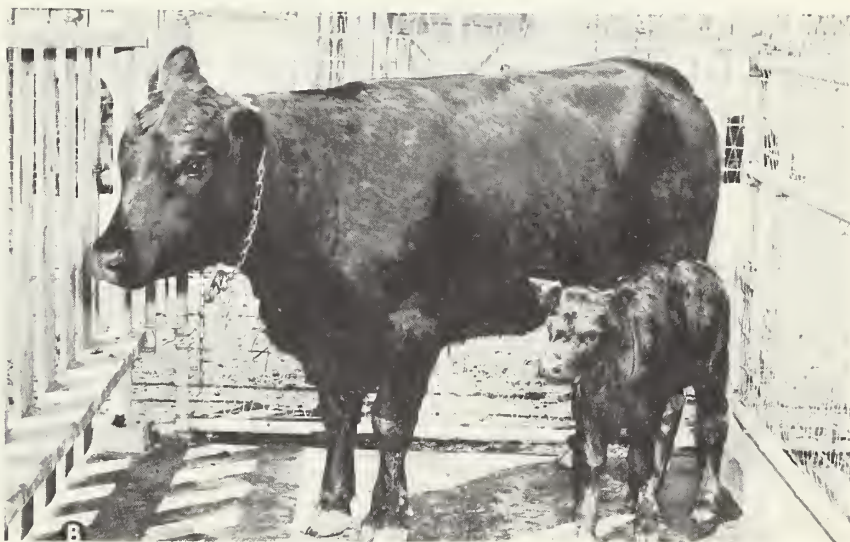
Steer B

Identical twin steers, each photographed when it reached 1,000 pounds. Steer A was continuously well fed. Steer B was on a maintenance ration for 6 months, then returned to full feed. Steer A reached 1,000 pounds 2 months sooner than steer B.

that bloat is more apt to occur when soybean oil is added to the ration at levels of 4 to 8 percent.

Poor reproductive performance, as evidenced by low percentage of calf crops, is considered the most important problem of the beef industry. Nutritional factors are being studied at the Center in a project that includes feeding rations of varying levels of total feed intake (energy and protein) to breeding females. Estrus, ovulation, conception rates, and embryo survival are being studied. A preliminary experiment indicated that low protein levels reduced both calf crops and weaning weights. After 3 years of feeding low levels of energy or protein, or both, the reproductive cycle of cows ceased. Heifers that conceived calved normally and their calves were small but healthy. Heifers on high-energy diets conceived normally, had heavy calves, but had considerable trouble calving, suffering heavy death losses among the calves.

Experiments were started in 1950 with identical twin cattle to determine the effects of continuous versus interrupted growth on beef cattle. Identical twins are rare, probably occurring not more frequently than once in 2,000 or more calvings. Each pair of identical twins used in nutrition research yields results that are comparable with those obtained from considerably larger numbers of less closely related animals. Experiments with identical twin cattle are being carried out to determine the mechanism of response when animals are placed on full feed after having been fed rations limited in calories for periods of up to 7 months. Early experi-



Aberdeen Angus females and their calves used in studies relating nutritional levels to reproductive performance. Heifers A and B gave satisfactory reproductive performances: A, Fed a high-energy diet, raised a normal calf, although similarly fed heifers had heavy calf losses; B, fed a medium-level energy ration, raised a vigorous and sturdy calf. Heifer C, fed a low-level energy diet, calved normally, but most animals fed on this ration failed to conceive.

ments showed that animals fed restricted caloric rations for scheduled periods responded very favorably to full feedings, as measured by daily gains, feed consumption, and carcass characteristics, when compared with cotwins that were continuously fed full rations.

Data accumulated up to 1960 on pasture utilization studies indicate that animals grazed on wheat and sudan-grass pastures (annual mixtures) gain more rapidly than those on perennial orchardgrass-Ladino clover pastures. The information from the pasture studies on comparison of perennial mixtures and annual mixtures should be applicable to the mid-Atlantic coastal area when animals are placed upon pasture without supplemental feeding.

Research on feeding pelleted rations for beef cattle indicates that fattening animals consuming complete mixed and pelleted rations require less feed per pound of gain but do not gain any more rapidly than those fed unpelleted rations.

Studies to determine ration digestibility have been underway for several years. These experiments are part of an overall program to study, and attempt to improve, research techniques used in the evaluation of feeds and forages. Comparisons of technique results show that substantial errors are sometimes found even in determinations made under well-controlled conditions.

High levels of salt are used by stockmen to control the daily intake of feed supplements by beef cattle and to increase water consumption in an attempt to reduce the incidence of urinary calculi. Studies are in progress to measure the effects of increasing levels of salt on feed consumption, digestibility, and efficiency of utilization of the feed.

Dairy Cattle Research Branch

Dairy research at the Center is concerned with the problems that affect the efficiency and profitableness of dairy farming. The work includes (1) studies in breeding and management to improve the milk-producing ability of dairy animals; (2) determination of nutritional requirements for normal growth, lactation, and reproduction and the feeds or feeding regimes that

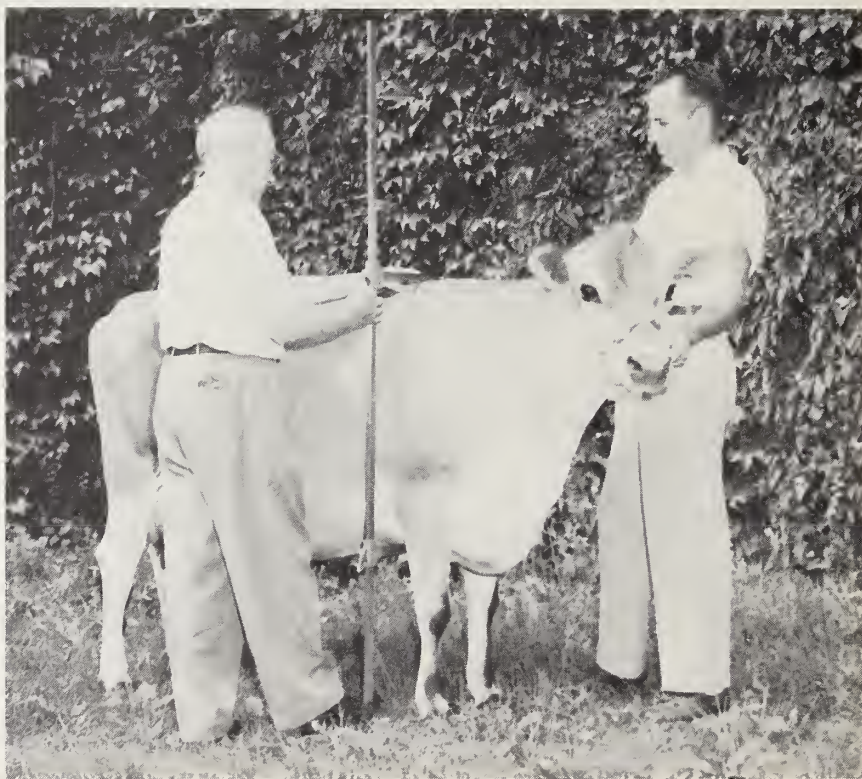
will supply the needed nutrients most efficiently; (3) investigations of the physiological factors affecting the general usefulness of dairy cattle; and (4) investigations on the nutritional value of milk.

The experimental herds used for breeding and nutrition studies consist of about 500 animals of all ages, including Holsteins, Jerseys, and crossbreds of various breeds. The facilities are barns to house the experimental herds and offices and special laboratories for the administrative and research staff. About 50 specialists in genetics, animal breeding, anatomy, physiology, chemistry, bacteriology, nutrition, and dairy husbandry work on about 60 projects. Approximately 600 acres is used for pasture and hays crops in connection with dairy operations.

Building Better Dairy Herds.—One of the problems in breeding dairy cows is the large number of low milk producers that are born in many farmers'

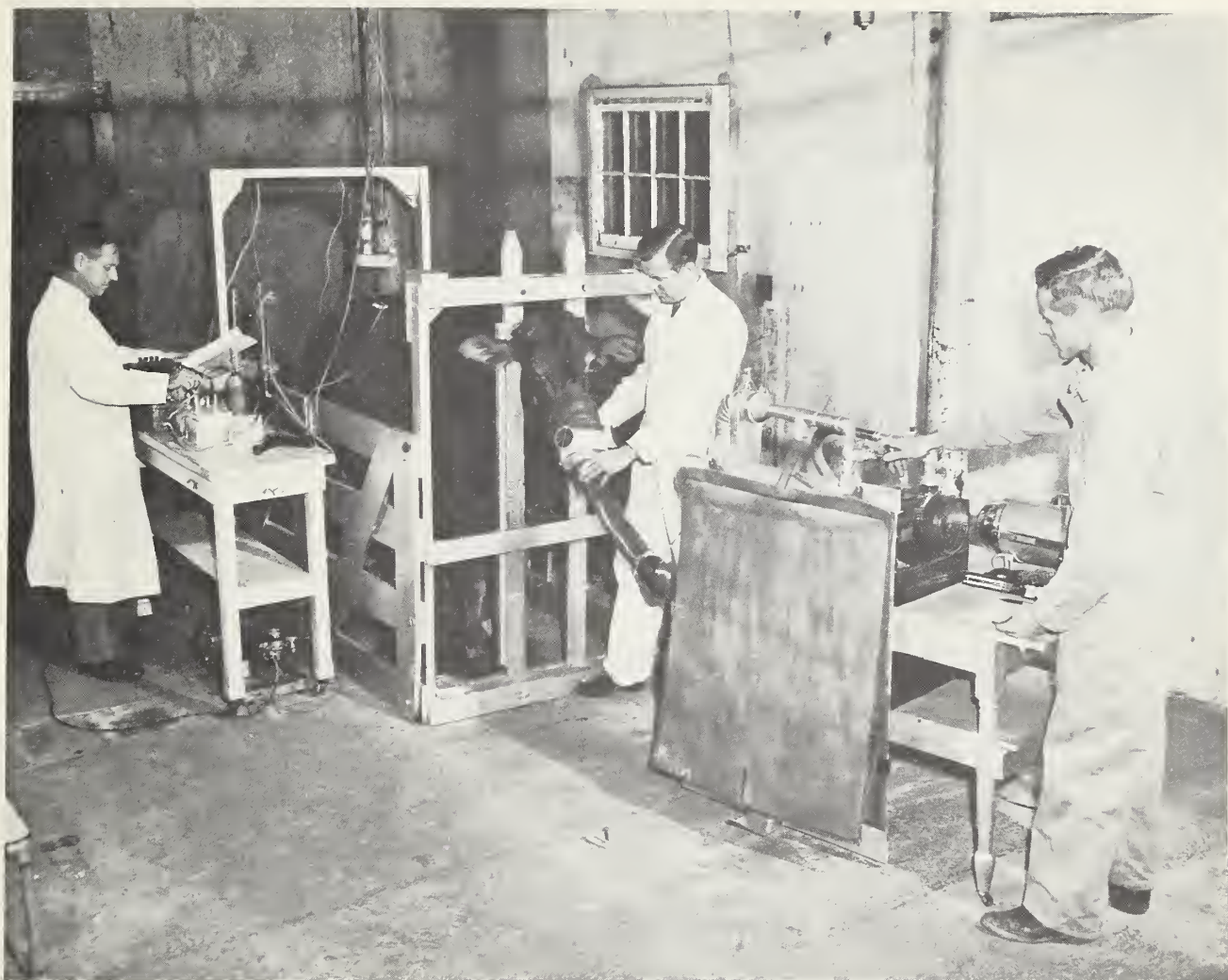
herds every year. It has been estimated that one-third of the country's dairy cows return a profit, one-third show neither profit nor loss, and one-third fail to pay for their keep. On the dairy farm, cows that do not pay for their keep are usually culled. Since an objective at the Center is to get information on breeding, all females are raised and tested for production. Every effort is made to avoid practices that might alter the interpretation of results in terms of inheritance.

A herd of registered Holsteins was established at the Center in 1918. It was maintained for experimental purposes, chief of which was to determine the value of using proved sires. The females in this herd today total more than 220 and represent daughters of 18 sires. They are the result of from 5 to 10 generations of continuous proved-sire breeding. The number of low milk-producing cows has gradually diminished with each succeeding proved-



BN-5783

Scientists studying body conformation and anatomy of a dairy cow to learn how cattle develop and the relationship of their development to production.



N-12297

Scientists measuring respiration rate and volume of skin evaporation under hot conditions in the adaptability laboratory at the Center.

sire cross, and the butterfat production per cow now averages about 700 pounds as compared with 540 pounds in the foundation herd, an increase of approximately 30 percent.

This herd is presently serving as a foundation group for a new experiment, in which three systems of mating are being compared. One-third of the herd is being used to continue the present practice of utilizing superior proved sires that are distinctly unrelated to each other. Another third of the herd is being closed and improvement will be attempted through selection and inbreeding. The final third is being bred to superior proved sires of breeds other

than Holstein-Friesian. All the sires are being selected on the basis of showing the most promise of maintaining or increasing the existing levels of milk, butterfat, and solids-not-fat. Young sires developed from each plan of mating are to be loaned to cooperating dairymen, so that a comparison can be made of the results of the three systems of mating on the performance of the cows and also of the bulls. Sire services for this research are being obtained from artificial-breeding organizations through the cooperation of the membership of the National Association of Artificial Breeders.

The original crossbreeding experi-

ment, which was started in 1939, entailed the use of proved sires of the Holstein, Jersey, and Red Dane breeds crossed with females of these breeds and also with Guernsey females. This initial study has been completed and a new one started, which is comparing the results of crossbreeding to purebred matings through reciprocal crosses of the Holstein, Brown Swiss, and Ayrshire breeds. The differences in milk and butterfat production among the breeds used are being evaluated, and the effect of crossbreeding on these differences will be estimated.

To learn more about the ability of cattle to adapt themselves to different



N-10883

A dairy-management specialist examines the stems of cut alfalfa that have been crushed by the heavy rollers of this modern machine—the mower-crusher—to make the stems dry faster and thus decrease the time required for field-curing the hay.

environments, particularly in the South, considerable research has been carried on in regard to their physiology and genetics. Much of it is conducted in a specially constructed heat chamber, where temperature and humidity can be controlled or varied as the experimental procedure requires. Measurements are made of heat losses through respiration and from the skin and also of certain physiological responses within the body. Results have shown that high production makes it more difficult for a cow to be heat tolerant. Tests have indicated that not only have cattle the ability to sweat but also this ability varies considerably among animals. These tests have also indicated that the amount of surface area on the skin and the presence of the dewlap and hump do not explain the measured differences in heat tolerance.

To provide a proper basis for identifying both superior and inferior milk-producing capacity, scientists at the Center have been conducting a study in which the body form of the heifer and the cow is measured, and after slaughtering the size of all internal organs and body parts is determined. More than

540 cows with records of production have been slaughtered and measured according to this procedure. In addition, more than 460 cows of known milk-producing capacity have been slaughtered and measured as a part of the same study at various State agricultural experiment stations. The work has already provided data showing how dairy animals grow and how their form changes with age, as well as the average weights and measurements of the anatomical parts of the cow, all as a scientific approach to the yet-unsolved puzzle of judging production from conformation.

Special emphasis has been given to a study of the udder. When a cow or heifer is slaughtered at the Center, the udder is removed, suspended in natural position, filled with formalin, frozen, and later cut into vertical slices to show the structure of the glands at various ages and to provide a basis for studying the relationship of tissue structure and producing ability. The sectioned udders are photographed. Several hundred specimens of typical and abnormal udders have been preserved and are avail-

able for examination by visitors and students.

After several years of research a method has been developed that may make it possible to prejudge the potential milk-producing ability of a calf when she is only 4 to 5 months old. Examination by palpation of the udder shows marked differences in the development of the mammary glands in individual calves. It has been found at the Center that, in general, calves with relatively advanced development tend to make better milk producers than those with retarded development of the mammary glands at the same age. If these results are upheld by field tests now in progress, some of the selection of herd replacements should be possible during early calthood and a preliminary appraisal of a herd sire might be obtained when his daughters are less than 6 months old. The palpation examination is not difficult and can readily be demonstrated.

Breeders have long been in need of genetic information on the solids-not-fat portion of milk. The Dairy Cattle Research Branch has tried to adapt the Watson-lactometer method, which was developed by Department scientists, for use in the field. New portable equipment that requires small amounts of milk for sampling has been developed experimentally and tested with co-operators. Solids-not-fat tests are being made routinely within the herd at the Center. The Branch is participating in an interstate cooperative study on the genetics of these milk constituents, and tests are being made with a large number of cows.

Exploratory studies are underway regarding methods of measuring the efficiency of feed utilization in lactating cows. All the breeding effort in dairy cattle has been to develop a cow that produced a gross amount of milk without knowing whether it produced most efficiently. These studies are designed to find out whether differences in efficiency between cows do exist and if so, how factors such as body weight and breed affect these differences.

In addition to the work at the Center, the personnel there are actively engaged

in cooperative investigations with research workers in more than 15 States and several countries on the reliability of sire provings, inbreeding, crossbreeding, adaptability of dairy cattle to the gulf coast region, methods of utilizing artificial breeding, environmental adaptability, body form and internal organ measurements, udder palpations, genetics of milk constituents, feed utilization, and blood typing. Cooperative studies are also being made with the Agricultural Engineering Division and the Eastern Utilization Research and Development Division on milk recording and milk handling, as well as on the development of a marker that will make it possible to identify the presence of antibiotics in milk.

Dairy Cattle Nutrition and Physiology.—Considerable emphasis in the research program is given to problems of preserving and processing grassland crops. In cooperation with the Agricultural Engineering Division, studies are conducted on the use of preservatives in silage, different types of silos, various types of covers for bunkers and stacks, and the effect of harvesting and other storage procedures on nutrient preservation and silage quality. Investigations of fundamental bacteriological and chemical changes in silage make it possible to recommend the best methods of producing dairy cattle feeds under a wide variety of farm conditions. In conjunction with the forage preservation work, studies are conducted on the effects of such harvesting procedures as pelleting, chopping, and laceration, and storage procedures on palatability and nutritional value of hays. Comparisons are also made of the feeding value of hays and silages for growth and milk production of dairy cattle.

In pasture research different management systems are evaluated—rotational and strip grazing, zero grazing, and irrigation. Pasture mixtures of such plant species as millet, sudangrass, and bermudagrass are also being studied for use in special locations and certain management practices.

The recently developed energy metabolism laboratory conducts fundamental and applied research on the energy evaluation of feeds and rations.

Studies on the usefulness of feed additives—antibiotics and hormone supplements—and on the basic nutritional requirements of rearing dairy heifers are also included in this general area of research. Work is also conducted on rumen metabolism and the function of paunch bacteria in the digestion and utilization of feeds, the growth of calves, and other problems related to rumen metabolism.

Basic physiology of reproduction in relation to sterility in cattle includes studies on ovulation mechanisms, the defense mechanisms of the uterus, hormone mechanisms, and the role of nutrition and genetics in relation to repeat breeding and other reproductive disorders.

A rat colony is maintained for basic nutrition research. The colony has provided important leads in basic nutrition, especially in relation to vitamin B₁₂, and has provided data on the nutritional values of butter, butterfat, cheese, and other dairy products. Work is also continuing with the rats on the isolation of unidentified nutrients that may be in certain feeds.

Techniques have been developed for evaluating carotene, vitamin A, and organic acids for use in forage and nutrition research. The use of ratio techniques for digestibility studies has been developed. A new technique to determine energy expenditure of cattle while pasturing shows great promise. Considerable emphasis is being placed on feed fractionation studies to develop an analytical method that measures more exactly the nutritional value of feeds than does the system now in use.

Meat Quality Laboratory

The object of research in animal breeding, nutrition, and management is the production of more meat of better quality. To obtain this objective the Division maintains at the Center a complete meat laboratory with modern facilities for slaughtering and processing experimental animals. These facilities are augmented by laboratories for chemical, biochemical, organoleptic, and histological evaluation of the meat and also by an office for statistical analysis of the data.

Cattle, hogs, and lambs from breeding, feeding, and management experiments are slaughtered in the meat laboratory, then measured, cut, and analyzed for physical composition—muscle, bone, and fat. In this way research workers have established standards for meat-type hogs yielding a large proportion of preferred cuts. Similar standards of excellence are being established for cattle and lambs. Objective methods of estimating the composition of live animals are being investigated, and methods have been developed and are being improved, as well as new methods studied, for determining the amounts of fat, moisture, lean, and bone in animals.

Studies of factors relating to palatability of the meat are made by trained taste panels and by objective techniques. Mechanical devices have been designed and are used to determine objectively tenderness and juiciness of the heated meat samples from the experimental animals.

Detailed microscopic and chemical studies of meat samples are in progress. The object of these studies is to (1) determine the relationship of production factors to tenderness and flavor of the meat, (2) provide a sound basis for the improvement of meat-animal production, and (3) create a greater demand for quality meat by the consumer.

Poultry Research Branch

Poultry-Breeding Developments.—The experimental poultry plant includes 177 acres, on which are 4 laboratory buildings, 11 large laying houses, 2 wooden brooder houses, 1 large concrete brooder house for 20,000 chicks, 6 large turkey houses, and nearly 200 colony houses of various sizes for the experimental flocks and equipment. The poultry buildings have a capacity of approximately 8,000 adult chickens and 1,500 turkeys. Facilities are available for brooding about 35,000 chicks and 2,500 poults. About 150,000 eggs are incubated annually. The experimental flocks are made up principally of Rhode Island Reds, White Leghorns, New Hampshires, Anconas, Black Australorps, Black Minorcas, and hybrids.



BN-5784

Chicks and poults are hatched in wire baskets—the offspring of one female per basket—to provide pedigree records in poultry-breeding projects.

Experiments in outbreeding, crossbreeding, and crossing of inbred lines (hybridization) are conducted to improve egg production. Crosses between selected White Leghorns and Rhode Island Reds, with and without previous inbreeding, have improved viability and produced from 35 to 50 more eggs per hen than the control stock of White Leghorns and Rhode Island Reds.

Selective breeding for several years has resulted in chickens that produce eggs of superior interior quality with a minimum of seasonal variation. A current experiment is designed to determine whether superior egg production, egg weight, hatchability, and viability can be bred into these same birds.

Studies of blood types in the fowl are being made to determine how the various types are inherited and whether these characteristics can be used to identify individuals and lines with superior performance potentials.

The Beltsville Small White Turkey.—The Beltsville Small White turkey is the product of an experiment in the pedigree breeding of turkeys, with the specific objectives of small size, quick market maturity, compact meaty body, and good reproductive ability. Average weight at full market maturity (22 to 24 weeks old) is about 7 pounds ready-to-cook for the hens and about 12 pounds for the toms. Several types and strains of turkeys were combined to produce the new turkey, which was admitted to the American Standard of Perfection in 1951 as a new variety.

After World War II the Beltsville Small White turkey was widely accepted by the industry and became well established in the United States. These small-type white turkeys are marketed when about 16 weeks old as turkey fryer-roasters or "turkey broilers" and weigh from 4 to 8 pounds ready-to-cook. They are actually small roasters and seldom are fried or broiled. In 1956 about one-sixth of all turkeys in the United States were Beltsville Small Whites. Of these estimated 13 million birds, nearly 73 percent were marketed as fryer-roasters. Breeding work is being continued, and surplus poults may be purchased by the public for breeding purposes.

National Poultry and Turkey Improvement Plans.—The National Poultry and Turkey Improvement Plans are administered from the Center. Through these programs the Agricultural Research Service cooperates with the States and industry in formulating provisions to govern the classification of breeding stock, hatching eggs, chicks, and poults produced by participating hatcheries, breeders, and flockowners. These classifications provide for the identification of products in regard to breeding improvement and for the control and eradication of pullorum, typhoid, and other infectious diseases. The organization that administers the Plans disseminates new research information on breeding and disease control. Approximately 60 percent of the hatch-

eries with more than 70 percent of the hatching-egg capacity in the United States participate in these programs.

Poultry-Product Quality.—Poultry-product technologists are studying the effects of different breeding, feeding, and management practices on the meat yield, carcass composition, and carcass quality of chickens and turkeys. Investigations on the microbiology of the egg are directed at the determination of basic factors causing the deterioration of shell egg quality. Improved methods of measuring egg quality are being investigated. Typical examples of results are a shell-color grading machine, an automatic detector of green rots, which has been plant tested, and a blood-spot detector, which is being distributed by a commercial firm. These and other



BN-5786

Breeding, feeding, and management experiments result in high-quality, plump-breasted chickens and turkeys.

automatic devices for grading eggs are being studied in cooperation with the Department's marketing specialists and engineers.

Physiology and Embryology of Poultry.—Studies on the basic nature of the reproductive system of the hen have shown that the cyclical nature of laying performance is due to a periodic interaction of nervous-system activity with hormone activity. Some barbiturates interfere with this interaction and others cause a premature response. Progesterone, a hormone once thought to be present only in mammals, has been found in chickens. This substance, when injected into regularly laying hens, causes premature ovulation. Recent work demonstrates that progesterone acts directly on the hen's brain to cause the release of a hormone from

the pituitary, which in turn induces ovulation.

Studies on fertility have shown that embryonic development of parthenogenetic origin occurs in eggs of nonmated Beltsville Small White, Light Palm, and Broad Breasted Bronze turkey hens and of nonmated Dark Cornish and Silver Cornish chickens. Parthenogenesis in turkey and chicken eggs has been confirmed by other laboratories. More than 50 parthenogenetic poults have been hatched from eggs of Beltsville Small White Turkeys. Six of these poults have been raised to maturity. A parthenogenetic turkey male hatched in 1958 from an unfertilized egg has produced viable semen in quantity. This semen was used to inseminate virgin Beltsville Small White hens. More than 80 offspring, about equally divided between males and

females, have been sired by this parthenogenetic male. Selective breeding appears to intensify the tendency to produce parthenogenetic eggs, and the use of fowl-pox vaccine appears to increase the incidence.

Physiologists and agricultural engineers are engaged in an extensive study of the effects of environmental factors on the body processes of chickens. Chicks with large thyroid glands are able to resist loss of body weight and death at high temperatures (100° F. continuously) better than those with small thyroids. The large- and small-thyroid lines of chickens were developed through selective breeding. The physiologist's work will guide not only the engineer in designing poultry houses but the breeder as well in developing superior birds. Studies on the effects of limiting feed or water intake on



More eggs for less feed is the aim of this nutrition experiment.

BN-5785

chicks have shown that the adrenal gland is involved in the resistance to these stresses and that the administration of certain antibiotics may also protect the birds.

Studies on the artificial lighting of turkey-breeding stock have shown the males to be sensitive to the duration of the artificial light supplied to obtain out-of-season reproduction. Females are responsive to artificial light but are less sensitive than males. A combination of natural and artificial light to extend the light-day to about 14 hours seems to be about right. The intensity of artificial light endured by the males without adverse effects appears to be within the range of about 1 to at least 40 foot-candles at bird level.

Poultry Nutrition.—Nutritionists at the Center recognized that soybean oil meal would not give good hatchability and livability when used as the only protein concentrate in the hen's diet. They found that the addition of animal protein or a water extract of dried cow manure would correct this condition. After the discovery of B₁₂, this vitamin was shown to be the active factor in the animal protein and in the cow-manure concentrate. Further work at the Center showed animal and fish byproducts to be good sources of the vitamin. These studies led to the discovery that fish byproducts contain, in addition to B₁₂, another growth factor that is still unidentified.

More recently the egg yolk has been found to contain a factor that is different from the fish factor and that stimulates chick growth and improves feed conversion. The egg-yolk factor is soluble in fat solvents, whereas the fish factor is water soluble. Work at the Center and elsewhere with inedible fats and oils and poultry byproducts indicates that these materials are well utilized by poultry, since they improve both the rate of gain and feed conversion. This finding has been of considerable economic importance, since it created markets for products that were either surplus or waste and at the same time proved them to be of benefit to the poultry industry.

Other fields of investigation that are of current interest in poultry-nutrition

work at the Center are protein and amino acid requirements, calories and their relationship to the nutrients in the diet, particularly protein, effect of feeding and management of growing stock on subsequent henhouse performance, and effect of administering hormone-like compounds on turkey broilers. Work on the characterization and identification of the several unidentified growth factors is being continued. A new but important phase of the nutrition work is the use of radioisotopes to study the metabolism of the amino acids, fats, carbohydrates, and vitamins that are required by poultry.

Sheep, Goat, and Fur Animal Research Branch

More Productive Sheep.—About 850 sheep are used in breeding, feeding, management, and basic investigations at the Center.

Breeding investigations involve a long-term program of comparing selected purebred matings of Hampshire, Shropshire, Southdown, and Delaine Merino sheep with many of the possible two- and three-way crosses of these breeds in respect to fat lamb and wool production under farm flock conditions. Experimental work has shown that crossbreeding results in increased production of lambs and wool over the average production of the parent breeds. A new crossbred strain has been developed for both fat lamb and wool production under Eastern United States environmental conditions by mating Columbia rams to Southdale (Southdown × Corriedale) ewes. The performance of this strain is being compared with the previously listed farm sheep breeds. The performance of Targhee sheep under farm flock conditions also is being evaluated in order to ascertain the possibility of incorporating range (wool) type sheep in crossbreeding programs for optimum wool and lamb production.

Approximately 100 sheep are used each year solely in nutrition research, and in addition applied nutritional research is conducted with the breeding flock.

Basic research is directed toward metabolic disorders such as bloat and

urinary calculi; rumen metabolism and the effect of diet on the synthesis of amino acids and proteins by microorganisms; calorie-intake and protein requirements for maintenance, reproduction, and growth; and new and better methods of evaluating pastures and forages.

New and improved techniques such as the use of X-ray movies (cooperative studies with the New York State Veterinary College) and radioactive isotopes (cooperative studies with the Atomic Energy Commission) have added to the fundamental knowledge concerning ruminal motility, eructation, and metabolic activity within the rumens of sheep.

Cooperative work with the Crops Research Division has yielded promising results in the selection and development of new and improved forage plants for sheep. For example, research has shown that the palatability of sericea lespedeza for sheep was directly correlated with the plant's tannin content and that strains of sericea lespedeza could be developed that were low in tannin content.

Feeding tests have shown that pelleted feeds for growing and fattening lambs can lead to an increase in feed consumption, rate of gain, and feed efficiency. Fundamental work is now in progress to determine how pelleting affects the chemical composition and digestibility of feeds and to determine the effects on sheep of feeding pellets over extended periods of time.

Applied nutrition work with the breeding flock is being directed toward such problems as supplemental feeding of sheep during drought periods and during the breeding and lambing seasons and toward the selection of pasture species and methods of pasture management that will yield the maximum production of lambs and wool.

Environmental studies include comparisons of the performance of genetically similar sheep under conditions at the Center and other geographic regions of the United States. The effect of season and light on wool production and feed requirements and the reactions of sheep to high temperatures are also being studied.

A mixture of 1 part of phenothiazine to 9 parts of salt is available to the sheep at all times to control internal parasites.

Animal Fibers.—Wool, mohair, and other animal fibers are analyzed at the Animal Fiber Laboratory to determine the effect of breeding, feeding, and management on the quantity and quality of fiber produced.

Most of the wools used in the research program are individual fleeces from sheep of known genetic origin. The wool is scoured, carded, and combed, and at various stages during this processing the wool is measured for fineness, length, and variability. The findings are analyzed to determine the extent to which these characteristics can be used in a selective breeding program.

Studies are also conducted on the relationships among sorted, partially sorted, and unsorted lots of wool of various grades to determine the value of various degrees of sorting on the quantity and quality of the wool after processing.

Fleeces from sheep of known genetic origin, located in various geographical regions of the country, are studied to determine the effect of the environment on the quantity and quality of the wool. Biopsic skin samples from these sheep are also studied to determine the effect of the environment on the growth pattern of the wool. The results of this project are analyzed and are made available to sheep breeders, in order that they may plan their breeding programs so as to produce wools with characteristics that will be of the most value in the finished product.

Information regarding the early development of wool and fur fibers, as well as the correlative changes in the skin that take place during such development, is basic to understanding the nature of animal fibers. Histological preparations are made of skin sections from animals of different ages, with essentially similar methods being used for the various animals under investigation. These preparations are required for a detailed study of the prenatal and postnatal growth of fiber follicles of sheep and goats and such fur animals as mink, fox, chinchilla, and rabbit. The various factors studied in-

clude the fiber growth cycle, the manner of fiber-follicle grouping, the availability of energy-giving substances such as fat and glycogen within the skin, the activity of the skin glands, and the amount and manner of pigment-granule distribution. Results from this research can be used in selecting stock for the improvement of wool or fur fibers, as well as the skin, or pelt, of the animal.

Swine Research Branch

Research on hogs is conducted on an area of about 270 acres at the Center. The plant includes a 28-pen farrowing house, record-of-performance house, feed barn, and 50 colony houses on individual pastures. One breeding herd totals about 200 hogs, and about 250 litters of pigs are farrowed annually.

Swine-breeding research is directed toward development and improvement of methods by which hog raisers can produce most efficiently the kind of pork products most consumers prefer. Since housewives are demanding more lean cuts of pork and less fat, swine producers should raise the kind of meat-type hogs that will meet this demand. Special attention is given to the effects of selection—inbreeding and crossbreeding—on such characteristics as fecundity, viability, rate of growth, feed efficiency, and carcass quality.

In 1934 the U.S. Department of Agriculture imported 23 Landrace and 6 Yorkshire hogs to evaluate their performance in crosses with different domestic breeds. Seven inbred lines possessing varying amounts of Landrace blood were developed from crosses made at the Center. One line, which is of Landrace-Poland China breeding, has attained the status of a pure breed and is now recorded as the Beltsville No. 1 in the Inbred Livestock Registry Association, St. Louis Park, Minn.

Four other inbred lines have attained a similar status. The Minnesota No. 1 was developed at the University of Minnesota by crossing the Landrace and Tamworth breeds. The Montana No. 1, which is derived from a cross of Landrace and Black Hampshire, was developed at the U.S. Range Livestock Experiment Station at Miles City, Mont.,

in cooperation with the Montana Agricultural Experiment Station. The Maryland No. 1 was developed from crossing the Landrace and Berkshire breeds at Blakeford Farms, Queens-town, Md., in cooperation with the Maryland Agricultural Experiment Station. The Palouse resulted from crossing Beltsville-bred Landrace boars with Chester White sows. This line was developed at the State College of Washington at Pullman.

Breeding studies recently completed at the Center have shown that crossing selected inbred lines with outbred stocks of unrelated pure breeds offers an excellent opportunity for surpassing the performance of both inbred and noninbred stocks. In order to explore the possibility of using hybrid vigor more effectively in producing market hogs, a program of recurrent reciprocal selection similar to that used by corn breeders to increase hybrid corn yields was started at the Center with crosses among three of the Beltsville lines—Landrace, Landrace-Large Black, and Landrace-Poland China, representing the foundation stock for one of the two strains used in this program. The other strain was started from crosses among noninbred purebred stocks of Chester White, Hampshire, and Poland China.

The program is expected to continue for 10 to 15 years. It includes the following steps: (1) Crossing at 2-year intervals line-cross strain L with breed-cross strain B, (2) testing the resulting cross progeny for various economically important traits, (3) retention in strains B and L of breeding animals proved best by the performance of their cross progeny, and (4) propagation of strains B and L by mating selected animals for litters in intervening years. Selection of breeding animals for propagating strains B and L is primarily based on the performance of their cross progeny with respect to rate of growth and efficiency of feed utilization from weaning to a final market weight of about 225 pounds and various carcass characteristics such as thickness of back fat, percentage of preferred cuts, and loin eye-muscle area. The dams' prolificacy and mothering and nursing



N-21112

Probing back-fat thickness of live hogs electrically (A) and with the metal rule (B) as a method of identifying superior meat-type hogs.

ability are also considered. Although several cycles of selection will probably be necessary before the usefulness of recurrent selection can be evaluated, results obtained to date show that the progeny produced from crossing strains B and L excel both their parent strains in most of the traits being studied.

A second breeding experiment with swine now in progress at the Center is concerned with the effectiveness of selection for high and low back-fat thickness. Specifically the plan is (1) to determine the rate at which thickness of back fat can be changed by selecting individual pigs for high back-fat thickness in one line and for low back-fat thickness in another line within each of the Duroc and Yorkshire breeds and (2) to determine how selection for high and low back-fat thickness affects other traits, such as type and conformation, rate of gain, and carcass composition.

The primary criterion used in selecting breeding stock within the various lines is back-fat thickness at a live weight of 175 pounds. Results obtained to date show clearly that selection based on probing back-fat thickness of live hogs may be highly effective in changing the lean-to-fat ratio of hog carcasses.

Research in swine nutrition has been directed into a variety of fields. In vitamin studies major emphasis has been directed at establishing minimum requirements for gestation and lactation in swine and in checking requirement figures that have not been firmly established. This method of attack is being continued in order to fill in some of the more important and obvious gaps in our current knowledge of vitamin nutrition.

Progress is being made in reducing baby pig losses due to faulty nutrition. Female swine have been reared under controlled dietary regimes and carried

through two successive gestation-lactation cycles. Measurements have been made of the effects of diets of varying nutritional levels fed to the dams on the number, size, vigor, and survival of pigs born and on the average weight of pigs at a given age. A direct relationship has been established between inadequate nutrition and baby pig losses.

In the field of mineral interrelationships, studies have established a definite connection between the zinc and calcium contents of swine diets and the incidence and severity of parakeratosis, including tentative recommendations as to preventive and therapeutic levels of zinc. Studies are being continued to confirm or modify these tentative recommendations, to investigate the mechanisms in the production of parakeratosis, and to establish quantitative requirements for trace minerals, particularly in gestation and lactation diets for sows.

A series of tests to evaluate improved processing methods for producing by-product feeds have been primarily directed at the problem of toxicity of cottonseed meal for swine. Previous attempts to adapt cottonseed meal for increased use in swine and poultry feeds have been concerned with methods of

reducing the content of free gossypol in the meal. However, the discovery that both quantity and quality of crude protein in the diet modify the susceptibility of swine to gossypol toxicity has suggested another approach to the problem of rendering cottonseed meal safe for increased utilization in diets.

Other nutrition research entailing the cooperative efforts of several State experiment stations includes evaluation of cooked garbage as swine feed, a study of the development of the enzyme system in the pig, and investigations to measure the effects of dietary factors on carcass quality of market hogs.

Crops Research Division

The Plant Industry Station is the headquarters for a national program of field- and horticultural-crops research and related activities, designed and conducted for the betterment of the Nation's agricultural production. The extensive activities of the Crops Research

Division at the Station include field-plot, greenhouse, and laboratory work in plant breeding, plant diseases, and plant-growth studies, entailing pioneering research in such scientific fields as plant physiology, and plant pathology.

Developing Better Field Crops

Breeding for yield, adaptation, and disease and insect resistance, and investigations of disease-control methods, are the chief activities in the improvement of cereal, forage, fiber, tobacco, oilseed, and sugar crops at the Plant Industry



CR-7876

A potato specialist prepares to put potato fruits into a bag to assure the identity of crosses from hand-pollinated flowers.

Station. Collections of varieties of barley, wheat, oats, alfalfa, clovers, soybeans, tobacco, flax, rice, sugar beets, and grasses from all over the world are maintained.

The greenhouse facilities often make it possible to grow an extra crop during the winter months and thus speed the development of new varieties. Seed produced during the winter may be sent to another locality for spring planting, and this in turn may produce seed for a third crop, all in the same year. In this way seed of promising varieties may be built up rapidly and field tested at many locations for further selection.

The history of crop breeding for resistance to disease demonstrates that improvement of crop varieties is a continuous process. On one side is Nature's creation of new diseases. On the other side is man's constant search for genetic resistance and development of varieties that will stand up under attacks of disease organisms. To find needed resistance characteristics, it is sometimes necessary to make inoculation or other screening tests on thousands of varieties from all parts of the world. The search for resistance to race 15B of wheat stem rust—which included the screening of more than 10,000 varieties or strains—is an example. This work is done at the Plant Industry Station and at co-operating State agricultural experiment stations on cereals and other field crops. Once the desired plant characteristics are found, the long process begins of crossing and backcrossing to transmit these characteristics to good commercial varieties.

A story of long, painstaking work is back of almost every plant-breeding achievement in field crops. Hybrid corn, for example, was developed only after years of effort by many scientists. It has been generally adopted by farmers in the United States. In the central Corn Belt States hybrid corn is grown on almost all the acreage seeded to corn. This hybrid principle is now being applied to other crops.

Plant breeders constantly strive for crop varieties that have high and dependable yielding capacity and high

quality. Testing wheat varieties for high milling and baking qualities, barley varieties for malting quality, and feed crops for nutritive value are a part of the crop-improvement process. In cotton, for example, spinning quality is one of the important desired characteristics. Scientists at the Station carry on studies to determine fiber strength and spinning quality. On the basis of these tests they can predict the yarn strength of different varieties.

In addition to the greenhouse breeding and development work, testing and selection are performed in nurseries and field plots at the Station, including studies of grazing management of grasses and clovers.

Weed Control and Herbicides

Weeds may be controlled by cultural, mechanical, biological, or chemical methods. Combinations of these methods may often be required to control some weeds. Chemical weed control is now a common farm practice. Investigations at the Plant Industry Station include (1) an evaluation of chemicals for their herbicidal efficiency in preplanting, preemergence, and postemergence sprays for selective weed control in field and horticultural crops; (2) the relationship between chemical structure and herbicidal activity and the modes of action of herbicides; and (3) determination of the physiological effect of herbicides on plant processes and chemical composition.

The absorption and translocation of herbicides are also being studied to improve efficiency in killing deep-rooted perennial weeds and woody plants. Some herbicides are volatile; they may be lost in the vapor state before weeds emerge, or they may evaporate and injure adjacent susceptible plants such as grapes, cotton, and tomatoes. Plant scientists are attempting to change the molecules of herbicides in such a way as to reduce their volatility. The herbicidal properties of hundreds of new chemicals have been evaluated. The most promising ones are being studied more intensively under a wide variety of soil and climatic conditions at field locations.

Chemicals Regulate Plant Growth

Hundreds of chemicals are being investigated to detect new compounds that might regulate the growth, development, fruiting, or keeping quality of useful plants. New materials are first applied to plants in small doses, and those that appear to be effective are given extensive testing. Plant-growth regulators are used commercially to thin fruits; to prevent the dropping of the fruits, flowers, and leaves; to stimulate root growth on cuttings; and to check the sprouting of potatoes.

Radioactive tracers have been used to study the means by which these chemicals enter a plant, the mechanism of transport through the plant, and the final location in the plant tissues. The tracers have shown that growth regulators of the 2,4-D type are absorbed by the plant and transferred to the part that is developing most rapidly at the time of application. At certain concentrations the growth regulators retard the growth of broad-leaved plants (dicotyledons) but do not affect the growth of grasses (monocotyledons) appreciably. These effects are due to differences in the way the plant constituents react to the compound.

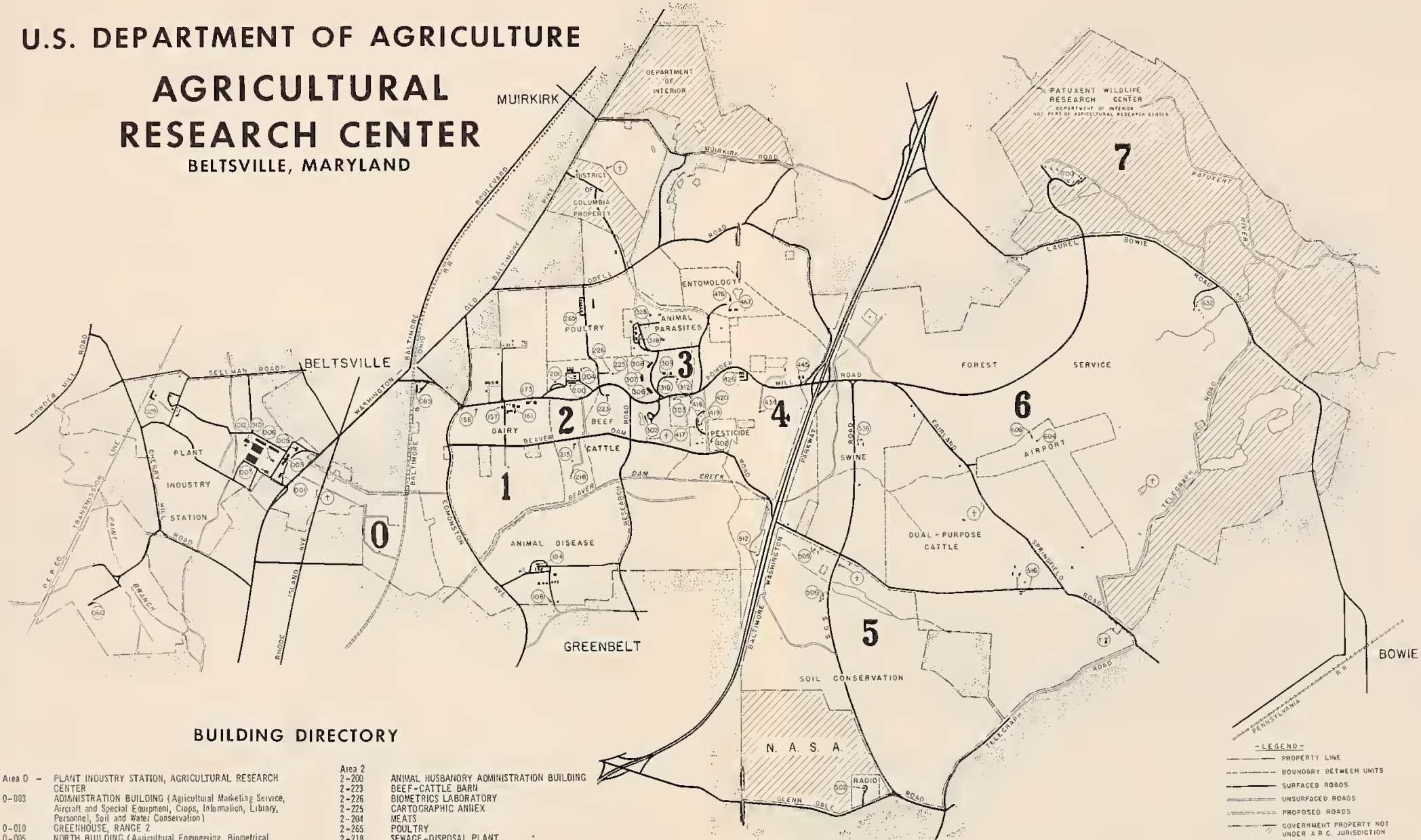
Possible future uses for growth-regulating chemicals include (1) holding back parts of a planting to permit a season-long spread of vegetables; (2) checking the growth of shrubs to keep them from dwarfing other plantings; (3) controlling top growth to let more soil nutrients get into the usable parts of a plant and thus increase its nutritional value; and (4) dwarfing a plant, such as alfalfa, so that it can be used as a growing mulch for corn or can furnish nitrogen in pastures without competing with soil-holding grasses.

A seedless greenhouse tomato has been produced experimentally by using a compound made of 2,4-D and certain amino acids. Experimentally the addition of boron to 2,4-D speeded sugar movement within a plant and helped it absorb and move 2,4-D faster to various parts. Bananas ripened with 2,4-D are uniform in color and are

U.S. DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH CENTER

BELTSVILLE, MARYLAND



BUILDING DIRECTORY

Area 0 - PLANT INDUSTRY STATION, AGRICULTURAL RESEARCH CENTER
 0-003 ADMINISTRATION BUILDING (Agricultural Marketing Service, Aircraft and Special Equipment, Crops, Information, Library, Personnel, Soil and Water Conservation)
 0-010 GREENHOUSE, RANGE 2
 0-005 NORTH BUILDING (Agricultural Engineering, Biometrical Services, Crops, Entomology, Forest Disease)
 0-012 SERVICE BUILDING, HEADQUARTERS
 0-029 SERVICE BUILDING, NORTH FARM
 0-060 SERVICE BUILDING, SOUTH FARM
 0-007 SOILS BUILDING (Soil and Water Conservation, Soils, World Soil Map (Soil Conservation Service))
 0-001 SOUTH BUILDING (Crops, International Relations)
 0-006 WEST BUILDING (Agricultural Marketing Service, Crops)
 0-085 GRANARY (East side of Washington-Baltimore Boulevard)

Area 1
 1-105 ANIMAL DISEASE AND PARASITE ADMINISTRATION BUILDING
 1-104 ANIMAL DISEASE LABORATORY
 1-161 DAIRY HUSBANDRY
 1-173 DAIRY PHYSIOLOGY
 1-157 DAIRY PRODUCTS LABORATORY
 1-156 UNITED STATES PARK POLICE SUBSTATION

Area 2
 2-200 ANIMAL HUSBANDRY ADMINISTRATION BUILDING
 2-223 BEEF-CATTLE BARN
 2-226 BIOMETRICS LABORATORY
 2-225 CARTOGRAPHIC ANNEX
 2-204 MEATS
 2-265 POULTRY
 2-218 SEWAGE-DISPOSAL PLANT
 2-215 SHEEP BARN
 2-201 SMALL-ANIMAL BUILDING

Area 3
 3-303 AGRICULTURAL ENGINEERING LABORATORY
 3-318 ANIMAL PARASITE LABORATORY
 3-307 CENTER LABORATORY (Agricultural Research Center Operations, Clothing and Housing (Institute of Home Economics), International Relations)
 3-312 FILM STORAGE BUILDING
 3-328 FOOD AND DRUG ADMINISTRATION BUILDING
 3-302 LOG LODGE (Cafeteria)
 3-308 NORTH LABORATORY (Cartographic (Soil Conservation Service), Entomology Laboratory, Human Nutrition (Institute of Home Economics))
 3-309 SERVICE BUILDING
 3-306 SOUTH LABORATORY (Entomology Laboratory, Grain (Agricultural Marketing Service), Pesticide Chemical, Soil Survey)
 3-310 WATER-TREATMENT PLANT

Area 4
 4-420 AREA OFFICE, SOIL CONSERVATION SERVICE
 4-445 AUTOMOTIVE SHOPS
 4-418 CARTOGRAPHIC NORTHEAST STATION
 4-476 ENTOMOLOGY LABORATORY A
 4-467 ENTOMOLOGY LABORATORY C (Forest Insect Laboratory)
 4-434 GOAT BARN
 4-426 MECHANICAL SHOPS
 4-417 MINERAL DEPOSITS BUILDING
 4-402 PESTICIDE REGULATORY TESTING BUILDING
 4-419 RADIO LABORATORY, FOREST SERVICE

Area 5
 5-516 DUAL-PURPOSE CATTLE
 5-512 HYDROLOGY BUILDING, SOIL CONSERVATION SERVICE
 5-509 NURSERY, SOIL CONSERVATION SERVICE
 5-502 RADIO STATION WWV
 5-506 SOIL MANAGEMENT LABORATORY
 5-536 SWINE BARN

Area 6
 6-604 AIRCRAFT AND SPECIAL-EQUIPMENT HANGAR
 6-606 FOREST INSECT HANGAR
 6-632 FOREST SERVICE (Virginia Pine-Hardwood)
 Area 7
 7-700 PATUXENT WILDLIFE RESEARCH CENTER
 ADMINISTRATION BUILDING

LEGEND
 - - - - - PROPERTY LINE
 - - - - - BOUNDARY BETWEEN UNITS
 - - - - - SURFACED ROADS
 - - - - - UNSURFACED ROADS
 - - - - - PROPOSED ROADS
 - - - - - GOVERNMENT PROPERTY NOT UNDER A.R.C. JURISDICTION
 - - - - - PRIVATE PROPERTY
 3 AREA NUMBER
 507 BUILDING NUMBERS
 T CEMETERY
 CHURCH





CR-N-12118

Plant scientists observe spraying of corn, soybeans, cotton, and wheat with a new chemical being screened for its weed-killing value.

sweet. Moreover, expensive ripening rooms, which are needed when ethylene is used for ripening, are not required. Peach thinning is possible with 3-Cl-IPC (isopropyl N-(3-chlorophenyl) carbamate). One of the deadliest weed-killers, 2,4,5-T, shows promise experimentally when used in a spray to hasten maturity of peaches and apples and to delay maturity and raise yields of bush lima beans.

Alpha-methoxyphenylacetic acid,

known as MOPA, is a fast-moving growth modifier that apparently moves both up and down in a plant. It forms a gall at the treated part of a young bean stem and a secondary gall at the plant tip. This stops tip growth, stimulates side shoots, and delays flowering and fruiting of the plant. MOPA may have value in making some plants shorter and bushier. It can move through adjacent roots from one plant to another and from one kind of plant

to another. Gibberellic acid is another growth regulator studied experimentally as it affects many field and horticultural crops.

Light and Plants

The effect of length of day and night on the growth and flowering of plants is being investigated in greenhouses and special chambers equipped to provide light or darkness at will. The studies include tests of different wavelengths, or colors, of the visible spectrum.

Length of night affects plant growth more than length of day. Red light stimulates growth of some plants. Far-red, the barely visible radiation on the edge of the spectrum, and infrared undo the effect of red light. Light has been used experimentally to regulate flowering, seed germination, coloring of tomato skins, and growth of bulbs, roots, and seedlings.

Antibiotics

New antibiotics and related compounds are screened for their ability to

control crop diseases. Streptomycin, the commonly used medical antibiotic, will control such plant diseases as halo blight of beans, wildfire of tobacco, fire blight of apples, and bacterial spot of tomatoes. Basic studies are made on the absorption and translocation of antibiotics and related substances, and new methods are being developed for testing and using them efficiently.

Better Vegetables, Fruits, and Flowers

About one-third of the vegetable and fruit research at the Plant Industry Sta-

tion concerns the breeding of better varieties and strains. Most of the remainder concerns crop quality, growth, nutrition, and the causes and control of fungus, bacterial, and virus diseases of vegetables and fruits.

Plant breeders at the Station also do research on ornamental plants. They have made available to the domestic bulb industry new varieties of lilies, and they are developing improved varieties of snapdragons, azaleas, carnations, and daffodils.

Lima bean varieties of good eating and market qualities and dependable



CR-704

A variety of vegetable and field-crop plants grown entirely under artificial light controlled for quality intensity and duration.

yields have been produced in several sizes that are adapted to different purposes and to wide areas. The development of commercially acceptable types of lima beans that are widely adapted and resistant to nematodes, insects, and diseases is the objective of a program that has become countrywide in scope through cooperation with State vegetable specialists.

Mosaic-resistant snap beans of superior quality, such as Topcrop, have been developed.

As a result of the national potato-breeding program of the Department of Agriculture in cooperation with the States, many new varieties have been produced that are popular with farmers and consumers. Careful breeding work is creating varieties of potatoes that are resistant to the major diseases, mature at the right time, adapt to a specific locality, and have good shape, shallow eyes, and high yield.

The hybrid onion industry has grown out of onion-breeding work. Many onion hybrids are now available to growers.

Sweetpotatoes are being bred for resistance to wilt and black rot and for high carotene content, eating quality, and yield.

The fruit-breeding work of the Crops Research Division and cooperating State stations is particularly valuable to growers of peaches, grapes, pears, strawberries, blueberries, and cranberries.

Strawberry breeders have grown more than 500,000 seedlings, from which a few thousand were selected for further testing. More than 25 have been named and introduced to the trade, and several others are under test. Some of these new varieties are widely grown commercially. One of these, the Blakemore, is the most extensively grown variety in the United States. Almost all the strawberries grown in the eastern part of the United States are infected with hidden virus diseases. Special testing techniques make it possible to isolate clean stocks of 25 varieties that have been propagated for release.

Tomato-breeding work in the Department of Agriculture began about 40 years ago. Prior to that, research aimed at developing resistance to fusarium wilt had been done in a few tomato-growing States. Since 1918 practically all the old varieties have been replaced by new varieties in commercial fields. The tomato acreage has greatly increased. The concentration of the industry has made the disease problem greater and the need for new varieties more acute.

Another phase of research is the introduction and testing of promising seeds and plants from other countries to determine whether they can be used in the genetic improvement of domestic crops. Introduction of the Peruvian wild currant tomato by the Department of Agriculture in 1930 gave great impetus to improving disease resistance in tomatoes. This species proved highly

resistant to fusarium wilt and several other diseases. It has been used by many breeders in developing new varieties, including some that are resistant to cladosporium leaf spot, a disease that is troublesome in commercial greenhouses and in some fields where high humidity and cool temperatures prevail during the growing season. Other wild species are being used as parents in attempts to improve disease resistance.

The Crops Research Division conducts research on nematodes in relation to plant growth, and it issues reports on currently prevalent plant diseases. It directs tree- and other plant-research activities at the National Arboretum, which is located at 28th and M Streets NE. in the District of Columbia.

Fungus Collections

The National Fungus Collections, second largest in the United States, contain more than half a million specimens of fungi. They are kept in the herbarium in the North Building, Plant Industry Station. They include the fungus specimens of the Department of Agriculture and the Smithsonian Institution. More than 25,000 species of fungi are included, and about 7,500 species are represented by type material or the equivalent. Particular attention is given to fungi that cause plant diseases. Fungus determinations are made, and mycological information is furnished.

Eastern Utilization Research and Development Division

Meat Research

The Eastern Utilization Research and Development Division maintains laboratories at the Center for research on the chemistry and microbiology of meat and meat products. The object of the work is to devise better methods of processing and preservation and to increase our knowledge of meat composition and characteristics.

To carry out this objective, facilities are maintained that include laboratories for chemical and microbiological research and pilot plant equipment for freezing and curing meat and for sausage manufacture. Special rooms pro-

vide almost every desired condition, such as controlled temperature (including freezing at 90° F. below zero), humidity, and air circulation. An air-conditioned smokehouse allows meat technologists to prepare and study a wide variety of products under practical conditions.

Problems under investigation are varied. Members of the staff separate meat into its component flavorful constituents by novel techniques and by using specially designed apparatus. Others study meat proteins by means of modern instruments and equipment and describe the protein characteristics.

Both chemical and microbiological studies of fat oxidation and rancidity of meat and the relation of bacteria to meat flavor also have a place in the program. Chemical and physical properties of meat that are important in maintaining quality in processed meat are studied, and an extensive collection of cultures of micro-organisms isolated from meat is maintained.

Cheese Research

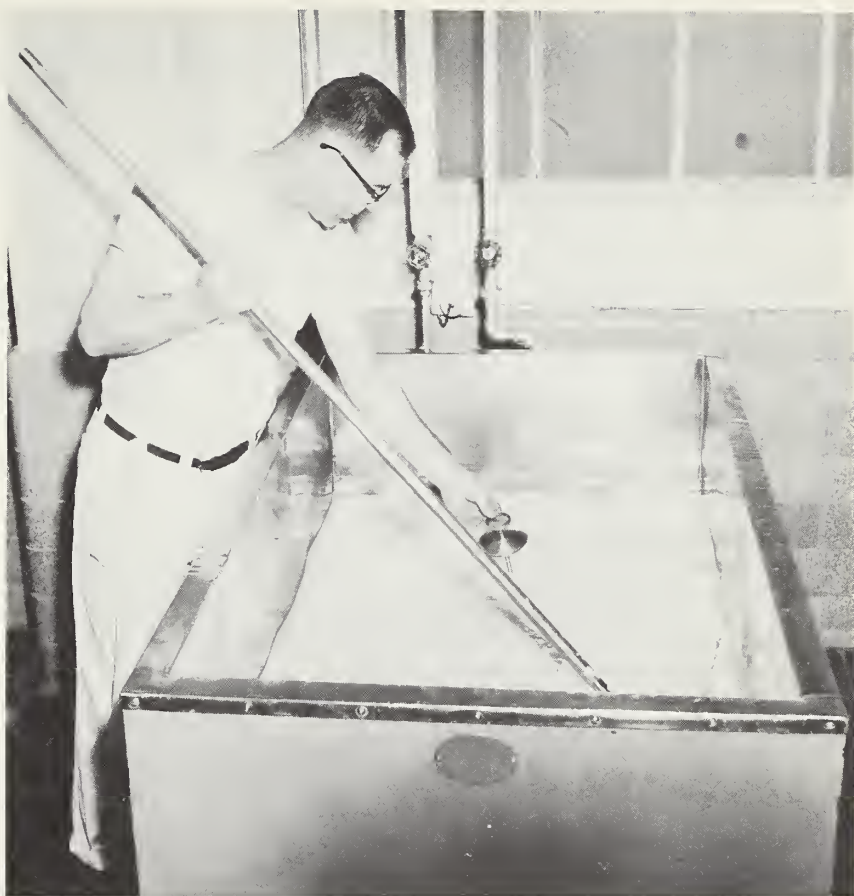
Research to develop cheesemaking procedures that will improve quality and simplify manufacture is being carried on at the Center. Experimental cheese is made on a pilot-plant scale.

All the steps in cheesemaking—from pasteurizing and curdling the milk through cooking, milling, and pressing the curd—and in curing are carried on with commercial-type equipment or equipment made especially for experimental work. Effects of different kinds and combinations of bacterial starters, cooking temperatures, procedures for cutting, working, salting, and pressing the curd, and curing conditions on quality and flavor are under study.

Improvement of methods for making Cheddar, Swiss, and cottage cheese is being studied. A method has been developed for making high-grade Cheddar-type cheese in half the time and with much less labor than formerly.

(NOTE.—The Eastern Division also maintains laboratories at Wyndmoor, Pa. (headquarters of the Division), and in Washington, D.C. Three other Utilization Research and Development Divisions are located at New Orleans, La., Peoria, Ill., and Albany, Calif.)

Stirring the cut curd during cooking, a step in the making of Cheddar-type cheese. The operator is reading a thermometer, since precise control of temperature is important.



EU-SBD-449

Entomology Research Division

The function of this Division is to protect man, animals, and plants from the attacks of harmful insects and to increase the usefulness of beneficial insects. Entomologists in laboratories and offices at the Agricultural Research Center study problems in these fields and supervise the activities of more than 100 entomology research laboratories located throughout the United States. Only a small part of Federal research in entomology is conducted at the Center.

Bee Culture

The Field Crop Insects and Bee Culture Research Branch maintains a laboratory at the Center for research on the biology and control of diseases and pests of the honey bee. Bee diseases cause loss of colonies, reduced honey production, depletion of bee populations needed for crop pollination, and expenditures by beekeepers and by

States to control diseases. The laboratory develops practical and economical methods of control of bee diseases and pests and provides a diagnostic service for beekeepers and State apiary inspectors. Included in this work is the screening of experimental insecticides for their relative toxicity to honey bees. A colony of honey bees is maintained in a glass observation hive for the benefit of visitors.

The laboratory also maintains a unit that annually answers thousands of requests from all parts of the United States and from foreign countries for information and publications on various aspects of bee culture. The Apiculture Unit of the Library of the Department is housed at the laboratory and contains thousands of books on bee culture and one of the most extensive bibliographies in the world on this subject.

Pioneering Research on Entomological Problems

Basic studies to develop helpful facts and background information on insects and related problems are carried on in the laboratories of the Pioneering Research Group. Unburdened by specific assignments, these scientists search for fundamental, practical facts that are needed by entomologists.

The Insect Physiology Laboratory conducts basic research on the biochemistry and physiology of insects, and the mode of action and metabolism of insecticides. This program is necessarily varied and flexible. Physiological research now in progress concerns nutrition, reproduction, and utilization and metabolism of essential nutrients. Studies on insecticides are aimed toward gaining a better understanding of



BC-1

Bee behavior is studied in glass observation hive.

their toxic action and the mechanisms of insecticide resistance.

A more thorough knowledge of the life processes of insects should allow us to exploit certain unique physiological or biochemical features to disrupt insect growth, metamorphosis, and reproduction. In addition, such research on insects will add to our knowledge of comparative physiology and lead to an improved understanding of the nature of these processes in higher animals. Just as information from other fields is

used in this laboratory, knowledge of insect physiology is useful in medicine, biochemistry, and many other sciences.

In the Insect Pathology Laboratory basic studies are made of various microorganisms that cause diseases of insects and of how these organisms may be utilized to control injurious insects. A diagnostic service is maintained for field stations of the Division, State experiment stations, and other agencies interested in determining the diseases of pest insects. Research is also con-

ducted in mass culturing and artificial dissemination of bacterial, fungus, and virus-disease organisms for economic control of many pest insects. Application by airplane of several virus diseases of forest and agricultural-crop pests is proving effective. Particular attention is being given to the possibility of utilizing diseases to control the codling moth, Mexican bean beetle, some species of armyworms, and several other destructive insects.

Finding More Effective Insecticides

Much entomological research pertains to insecticides and methods of applying them. The Pesticide Chemicals Research Branch conducts research to find new insecticidal materials that will reduce residue hazards and effectively control resistant insects. New organic compounds made by chemists are tested and then investigated at field stations.

Chemicals produced by plants are also tested for insecticidal value. In recent years the structure of pyrethrins, the active principles of pyrethrum flowers, has been worked out, and a compound similar to one of the major



TC-5459

Applying insecticides in aerosols on greenhouse tomatoes.



N-27826

Chemist selects information from tests recorded on punchcards to guide him in the synthesis of new insect attractants.

components, called allethrin, has been synthesized. Allethrin is now in commercial production.

Compounds are synthesized for testing by entomologists as repellents and attractants. The highly effective insect repellent diethyltoluamide was developed in this manner. Attractants used in insect surveys have resulted from this work. However, these attractants are very specific and a greater variety is badly needed.

The principle of applying insecticides by means of the aerosol bomb was developed by scientists at the Center dur-

ing World War II to help control insect-borne diseases. Aerosols have also been of great commercial value in the control of insects attacking such flowers as roses, chrysanthemums, and carnations and such greenhouse-grown vegetable crops as tomatoes and cucumbers. The physical and chemical properties of materials to be used in aerosols are investigated at the Center. Safe and inexpensive chemical solvents and propellents, types of valves, and deterioration in storage of both chemical materials and containers are studied.

Extensive airplane travel has greatly increased the accidental spread of harm-

ful insects. A method has been developed for automatic dispersion of high-pressure aerosols in airplanes while in flight that insures proper dosage without annoyance to passengers. Residual insecticides that are effective for some length of time are used in baggage and mail compartments of aircraft.

Particle size and other physical properties of insecticide powders are studied in relation to their effect on dustability, freedom of flow, dispersal by wind currents, and effectiveness as insecticides. Such data are very useful to entomologists and to the insecticide industry in determining the physical factors needed



A cockroach is dissected to find out how insecticides kill.

N-2487

to produce effective dusting mixtures of various insecticides.

Methods have been devised to analyze and determine the insecticide residues on fruits, vegetables, and forage crops. These results of residue analyses are used to adjust insecticide applications, so that the residues will conform to the official tolerances established under Public Law 518, 83d Congress, the Miller amendment to the Federal Food, Drug, and Cosmetic Act.

Thousands of test insects such as mosquitoes, flies, and cockroaches are reared under rigidly controlled conditions at the Center. Special strains are perpetuated and exchanged with other laboratories, so that results of tests conducted at the Center or elsewhere may be compared accurately.

Controlling Insects of Garden and Greenhouse

The Fruit and Vegetable Insects Research Branch conducts research at the Center on the control of insects of flowers and vegetables in the garden and greenhouse.

An important part of this work concerns studies of insecticide residues on vegetables. Insecticides are applied in sprays, dusts, and aerosols to many kinds of vegetables at recommended dosages for killing insects. Samples of the crop are harvested at various intervals after treatment and taken promptly to chemists for analysis of residues. The information thus obtained is used to determine the waiting periods necessary between the application of insecticides and the harvest of vegetables.

Insect contamination in processed fruits and vegetables causes heavy losses to processors and growers. Research is conducted to develop control of insects in the field and also effective dips and washes that will remove insects and their debris from the crops.

Laboratory studies by this Branch have shown that some strains of spider mites have become highly resistant to miticides. Some mite strains have retained their resistance for over 8 years, even though not treated with any miticide during this period. When these resistant mites mate with nonresistant mites, the offspring inherits the high resistance from either the male or female parent. New chemicals that are reputed to kill mites are tested in the laboratory against resistant mites in

efforts to find new effective materials where older ones are no longer satisfactory.

This Branch is also conducting studies in cooperation with the Crops Research Division to determine the insects that transmit virus diseases to chrysanthemums, gladiolus, carnations, lilies, and other greenhouse flowers; also to sweetpotatoes, lettuce, strawberries, and other vegetables and fruits. Studies are also being conducted to control these

pests with sprays, dusts, and systemic insecticides. One phase of the work is the testing of many combinations of insecticides, miticides, and fungicides on roses to develop general-purpose dusts and sprays for controlling insects and mites as well as diseases.

Insect Vectors of Animal Diseases

Livestock is afflicted by several diseases known or thought to be trans-

mitted by arthropods. Research is conducted at the Center by the Insects Affecting Man and Animals Research Branch in cooperation with the Animal Disease and Parasite Research Division to determine the role of insects and ticks in the transmission of certain diseases. Several species of ticks are being studied as possible vectors of anaplasmosis. Studies will be conducted later to determine the ability of biting flies and lice to transmit this disease.

Institute of Home Economics

The Clothing and Housing Research Division and the Human Nutrition Research Division study the usefulness and economy of fabrics, foods, and other goods and services from the stand-

point of the consumer. From laboratories and offices of scientists and other professional workers in these Divisions come facts to help the 50 million or more households of the Nation achieve

better living through more effective management of their resources. In addition to work done in the laboratories at the Agricultural Research Center, other research and the servicing



DN-1175

This energy-saving kitchen design incorporates research findings on energy expended for various household tasks and on space needs for housework.

of an interagency committee on nutrition problems are performed in the Washington offices by the Household Economics Research Division. Investigations are also carried on either co-operatively or by contract in almost every State.

Clothing and Housing Research Division

Determining Quality of Fabric and Garment Construction.—Clothing and

textile research helps consumers by providing practical information that will help them to decide the types of materials and the quality of workmanship that best serve their needs. To get the needed facts, the research often includes scientific laboratory testing that must be done under controlled conditions of temperature and humidity. In an air-conditioned laboratory many instruments are used to measure fabrics for strength, stretch, resistance to abrasion,

air permeability, fading, and other characteristics. Chemical properties of fabrics and the effect of washing agents or other chemicals on fabrics are also determined. These studies help to show the relation of fiber content, type of fabric, finishing processes, and quality and appearance of the fabric or garment in use.

Actual wear experiments add to what physical and chemical studies reveal about the usefulness of garments and



DN-1174

Measuring the breaking strength and elongation of a fabric by a high-precision, electronic, tensile testing instrument.

fabrics for specific purposes. Parallel- ing the laboratory experiments, these service studies also help to establish which of the laboratory tests best serve to predict or measure performance in use.

Considerable research has been and is being done to find out more about the cause of stretching and shrinking in knitted fabrics made of cotton or some of the manmade fibers. Other fabrics being subjected to actual wear and tested at various intervals of wear and cleaning are shirtings of different weaves, men's suitings of wool or blends of wool with other fibers, slip-cover fabrics, and cotton rugs with and without soil-retardent finishes.

Developing Recommendations for Fabric Care.—Another phase of the clothing and textile research leads to recommendations for improved methods for home care of fabrics, garments, and household textiles. Chemists, for instance, are finding out what concentrations and kinds of detergents, bleaches, and whiteners are best for fabrics with special finishes and for those made of the newer fibers. Working with equipment specialists, they are trying to find the reasons for the yellowing of white cotton fabrics. Bacteriologists study the effectiveness of compounds that are sold for the purpose of disinfecting or rendering fabrics bacteriostatic.

Developing Clothing Designs.—Clothing problems and needs of homemakers, including the physically handicapped, are investigated, and designs for clothing are developed that incorporate features providing for mobility, safety, convenience, comfort, and practicability. Materials with qualities and finishes that supplement functional garment design are sought, and those most compatible to the design and use to be made of the garments are subjected to actual wear to determine their suitability.

Designing Functional Houses.—Space dimensions and arrangements to meet family needs and preferences in rural housing, as well as the energy expended in carrying out household activities, are major subjects of housing research. For example, surveys of

farm-family activities have shown that home-food preservation is still so important in farm homes that it warrants special consideration in the planning of kitchens and utility rooms. Through laboratory determinations of space required for canning and freezing typical fruits and vegetables, housing specialists arrived at recommendations for counter space that should be provided in homes where food preservation is an important activity. They also determined the space needed for storing canned foods, canning equipment, and household textiles in farm homes. Under cooperative arrangements with colleges and experiment stations throughout the country, space needed for efficiently carrying out many other customary household activities is being determined by laboratory experiments.

Another aspect of the work in these laboratories is research to find out how much space is needed around household equipment and furniture for most efficient and effective use and care by homemakers. Measurements are recorded as homemakers perform household tasks involving use and care of major household equipment and furniture. Research is also being done to compare the energy costs of using equipment and storage facilities of different designs and arrangements, different types of equipment, and different methods of work. Findings of this research are used in designing storage facilities and developing arrangements of work and storage space that best conserve the energy of women, physically handicapped as well as normal.

Housing specialists and staff architects incorporate these research findings into designs for built-in facilities and arrangements of kitchens. The housing specialists also join forces with Department of Agriculture engineers in developing new farmhouse plans for distribution through the Cooperative Farm Building Plan Exchange, which the Department conducts cooperatively with State agricultural colleges. State colleges then supply the working drawings and plans to farm families. Other publications set forth principles of design useful in planning various parts of

the house and illustrate efficient layouts of space and equipment.

Equipment Performance.—Household-equipment research yields information on the performance of different designs of household equipment, and it assists families in selecting designs that meet homemaking needs. The facts obtained are presented in bulletins to guide consumers in the use and care of their equipment, to help manufacturers improve design of equipment to meet more nearly the needs of homemakers, and to provide teaching aids for educational and other groups working in the equipment fields.

As an example of this type of research, modern household equipment is being used for laundering some of the newer types of fabrics on the market to find out how different washing machines and dryers can be used most satisfactorily with each fabric. From such research will come recommendations for laundering present-day fabrics with a minimum of time and energy, making as full use as possible of the equipment, and at the same time satisfactorily cleaning fabrics without damage to their appearance and wearing quality.

Human Nutrition Research Division

Evaluating Food Quality.—Basic principles of cooking are investigated to discover the effects of different methods of preparation on the eating quality, yield, nutritive value, and safety of foods of different market qualities. Improved food-preparation and food-preservation procedures are developed to maintain or enhance food qualities that are important to consumers and thus promote economical and acceptable use of foods in homes, school-lunch programs, and institutions.

Eating quality largely determines consumer acceptance of many foods. Improper cooking methods are especially damaging to palatability of green and some other vegetables. Thus studies are being made to determine the best methods of cooking to maintain or enhance eating quality of selected fresh and frozen vegetables of varieties most



DN-1664

Color retention is one criterion used to evaluate cooking procedures for many foods, particularly green vegetables. This instrument measures the color of food and helps to determine the difference in color of food samples cooked in various ways.

commonly grown and marketed. Vegetables are cooked by several methods, including boiling with varying amounts of water for different lengths of time, steaming, and pressure and electronic cooking. Quality of the cooked food is determined by sensory testing panels and by objective measurements of color, texture, and flavor. The effects of cooking by various methods on the nutritive value of the vegetables are also measured.

Similar studies to determine the effect of age, breed, feed, or processing on the cooking quality, yield, and nutritive value of certain meats and poultry are also underway in cooperation with production and marketing agencies. Information from such studies help the homemaker to know the quality best suited for the intended use and how to use the qualities of products that are available. They also provide information valuable to those concerned with

the production and marketing of the foods.

Another phase of food-quality research deals with many foods—vegetables, fruits, and meats—that have been exposed to various insecticides during production. In cooperation with other Department agencies, scientists are attempting to measure flavor, odor, and general acceptability of these foods in relation to experimental insecticide treatments.

To help in the National School-Lunch Program, recipes utilizing abundant foods have been developed and standardized. A basic card file of these, including soups, salads, vegetables, main dishes, breads, sandwiches, desserts, and sauces, has been published. As new recipes are developed, supplements to this file are issued and distributed to schools cooperating in the National School-Lunch Program. The file contains the amounts of each ingredient

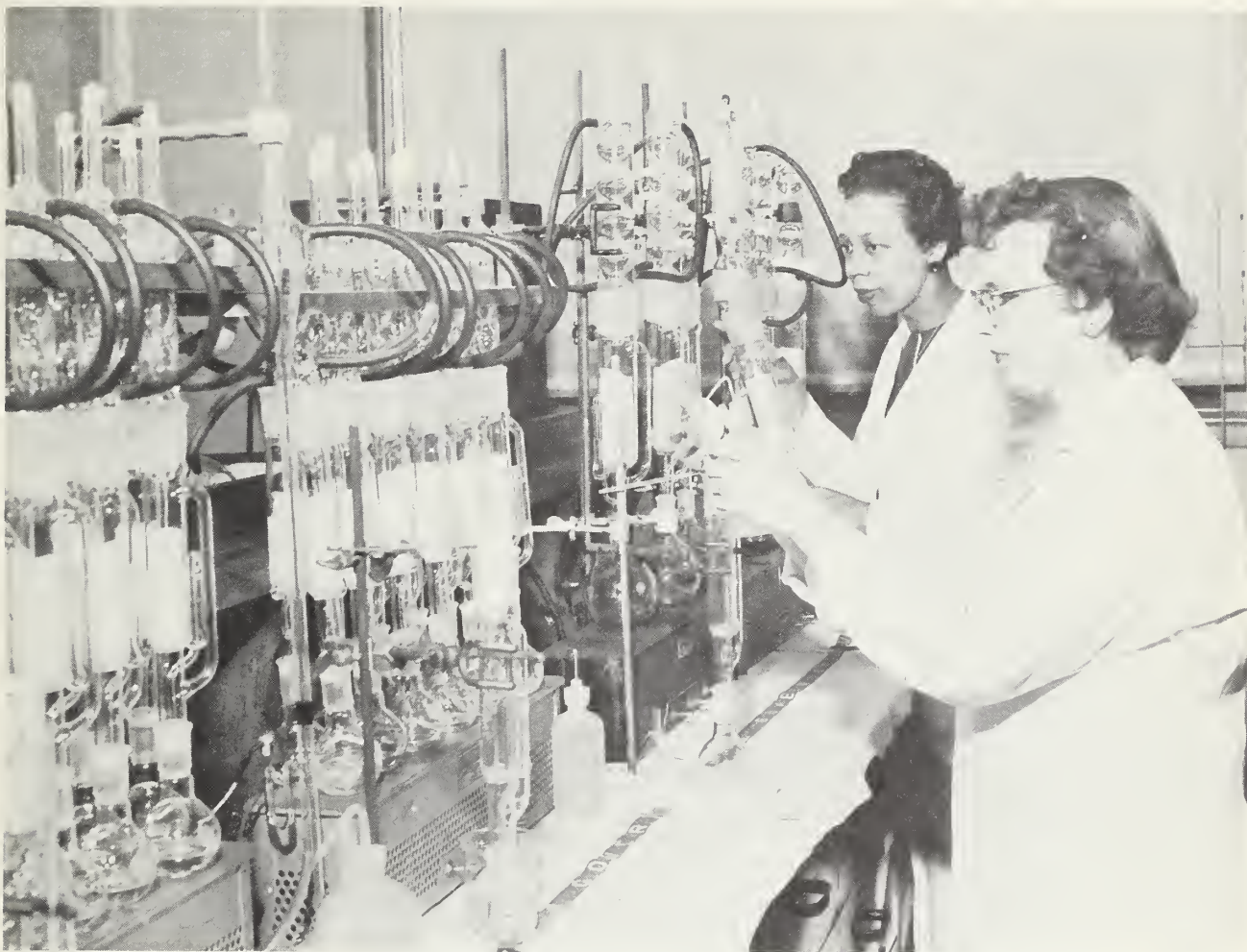
needed to give 100 portions of the size required for participation in this program. A buying guide was also developed to help supervisors and cooks estimate the amount of a commodity to buy in order to provide the quantities specified. This guide is based on studies made of actual waste and on yield figures, both collected from various parts of the country.

Determining Food Values.—Research is in progress continuously to determine the amounts and the kinds of nutrients in foods when they are bought and when they are prepared for eating. Data from the United States Department of Agriculture and many laboratories are summarized and published to meet the many requests for reference tables on the nutritive value of foods

Protein is required by the body for tissue building and repair. The protein value of a food is determined not only by its protein content but also by how much of each essential amino acid is present in the protein and by how much is available to the body. Methods have been developed and applied to determine the amount of the many amino acids present and the extent to which they are probably utilized in body processes. Studies are also made to find out how different kinds of cooking alter the availability of amino acids in high-protein foods such as meat, milk, beans, peanuts, soybeans, and cottonseed.

Fat contributes more than twice the energy value per gram that proteins or carbohydrates do; it constitutes about 40 percent of the calories of the average American diet. In addition, fats furnish small amounts of nutritionally essential fatty acids such as linoleic acid, long recognized as an “essential” fatty acid and now the center of much attention in nutrition research. Research is providing data on the fatty acid content of selected foods and on the effects of cooking on various fatty acids.

Many mineral elements are known to be essential in human nutrition. But figures now available on important minerals such as calcium, sodium, phosphorus, and iron refer to foods as produced and marketed 40 or more years ago. Studies are presently being made



N-33251

One type of equipment used to determine nutritive content of foods. The Soxhlet apparatus determines by ether extraction the amount of fat in raw foods or in foods as prepared for eating.

with several vegetables widely consumed in this country to find out their mineral content and possible differences in vegetables produced in different parts of the country and in different growing seasons.

Water-soluble B-vitamins are necessary for growth, activity, and reproduction. Assay procedures for thiamine, riboflavin, and niacin have been standardized. More recently assay procedures for some of the newer members of the B-vitamin family, namely folic acid and pantothenic acid, were perfected and their distribution in foods determined and published. Research now is directed toward developing de-

pendable methods for microbiological assay of two other nutritionally important B-vitamins, B₁₂ and B₆.

Research is providing more complete and more exact knowledge about the nutritive value of foods and how effectively nutrients are utilized by the human body. This information will help those planning diets to insure adequacy in the important nutrients.

Studying Human Nutritional Needs.—Amounts of many important nutrients needed by the body are not known, others are known only within broad limits, and there is but little precise information on the kinds and quantities needed by individuals in different

circumstances of age, activity, and environment. A great deal remains to be learned also about the comparative effect on health of different combinations of foods and nutrients. In the nutrition laboratories of the Department of Agriculture, research with rats and human subjects is helping to fill some of these gaps in knowledge.

Fatty acids, particularly those believed to be nutritionally important, are being studied to find out the amounts and kinds that children need for normal growth and development. From these studies a better understanding of human requirements for these constituents is emerging. Recently completed re-

search has also provided the first metabolic data, indicating the probable amino acid requirements of women. Studies underway will provide information on requirements of other groups in our population for these and other important nutrients.

One of the newer fields of research is the realm where teamwork among nutrients is being studied. It is known that the availability to the body of several nutrients is affected by the nature of the diet, i.e., the kinds and amounts of other nutrients present. Research

has shown that the kind of carbohydrate in the diet affected the body's use of amino acids and ultimately the body's composition. Rats are being used to find out the effect of other nutrients including fat on protein requirements.



PN-587

Nutritionists use rats to learn what happens when a single change—such as replacing sugar with starch—is made in a controlled diet.

Plant Pest Control Division

Testing Commercial Pesticides

In laboratories, greenhouses, gardens, and orchards located at the Agricultural Research Center, the Pesticides Regulation Branch tests samples from interstate shipments of commercial insecti-

cides, fungicides, disinfectants, rodenticides, weedkillers, and other pesticidal products. This Branch administers the Federal Insecticide, Fungicide, and Rodenticide Act of June 25, 1947, which is intended to protect farmers, livestock raisers, orchardists, and house-

holders from losses and possible personal injury through faulty, misbranded, or adulterated products. Under the law all such pesticides must be registered with the U.S. Department of Agriculture prior to being moved in interstate commerce.

**Methods Improvements
Operations**

The Division's Methods Improvement Operations staff has headquarters at the Plant Industry Station and a hangar and shops at the Center airport. Close liaison is maintained with the Center's research personnel and State and industrial organizations, to convert the latest laboratory research results into practical large-scale field operations. New pesticides and biological control methods developed by research in the laboratory are cooperatively tested on large field plots with both ground and aerial equipment, to determine effectiveness against destructive agricultural pests and safety to human beings, beneficial organisms, and wildlife. Technical supervision of the Division's aerial spraying and dusting activities is directed from this office and includes su-



N-35159

An airplane used in plant pest control supervision of aerial spray programs and in plant pest survey work.

pervision of actual spraying operations, selection of aircraft types, safety measures, specification of aircraft pilot standards, and efficiency of application.

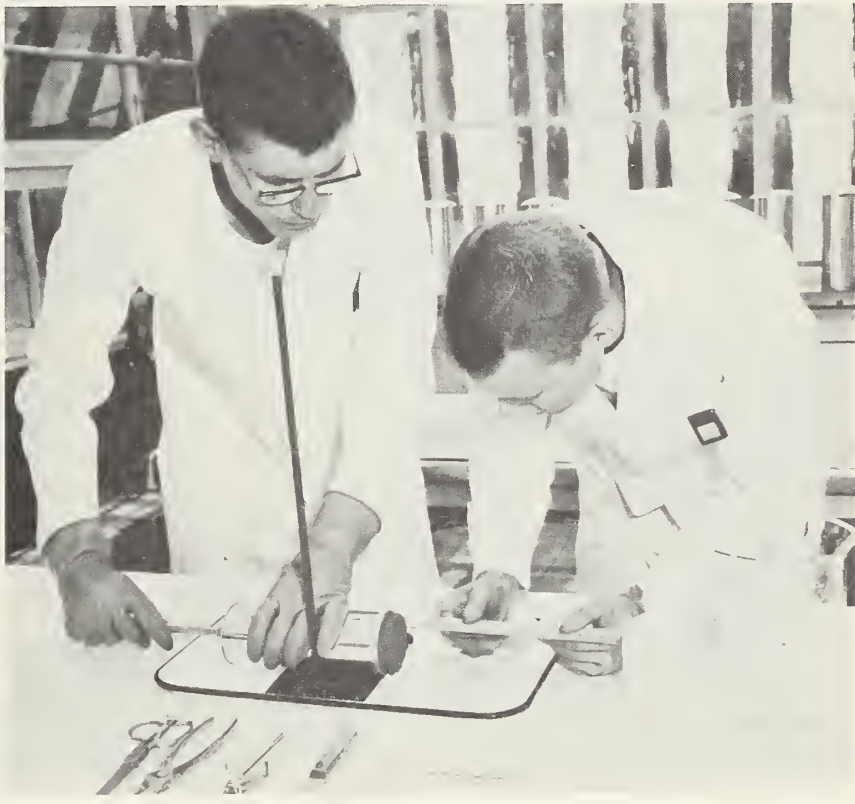
Soil and Water Conservation Research Division

Conservation farming means treating every acre according to its individual needs and using every acre within its individual capabilities.

Much conservation research is necessarily done regionally in cooperation with State experiment stations and other agencies. Headquarters for work on watershed hydrology and soil and water management are maintained at the Agricultural Research Center, but most of the research on these and other phases of conservation is carried on at field stations. Research on fertilizer technology and much of the basic research on soils and mineral nutrition are conducted at the Center.

Soil and Plant Relationships

The Soils Laboratory of the Eastern Soil and Water Management Research Branch at the Plant Industry Station also serves as a center for fundamental research on soil and plant relationships. Scientists conduct investigations on micro-organisms capable of fixing atmospheric nitrogen, and they study relationships of soil organisms to soil tilth and plant nutrition. Factors and principles pertaining to decay of plant materials, formation of humus, and



PN-585

Sectioning a soil column to determine how far a radioactive isotope has moved after leaching with water. More soil columns can be seen in the background.

other biological transformations in soils are studied. Fundamental investigations also are made on the chemistry of nutrient elements in soils and their availability to plants. Methods for soil and plant analyses, including spectrochemical analysis, are developed and tested.

The behavior of radioactive fission products, principally strontium 90, in different soils, the amount of radioactive material removed from the soil by erosion or leaching, and the factors that control the uptake and translocation of strontium 90 in plants are studied. Basic information is needed for planning the use of and the decontamination of agricultural areas contaminated with fallout materials. Another phase of this research, conducted cooperatively with the Agricultural Engineering Research Division, consists of

studies on the mechanical removal of radioactive contaminants from the soil. All radioactive fission products research is conducted in cooperation with the Atomic Energy Commission.

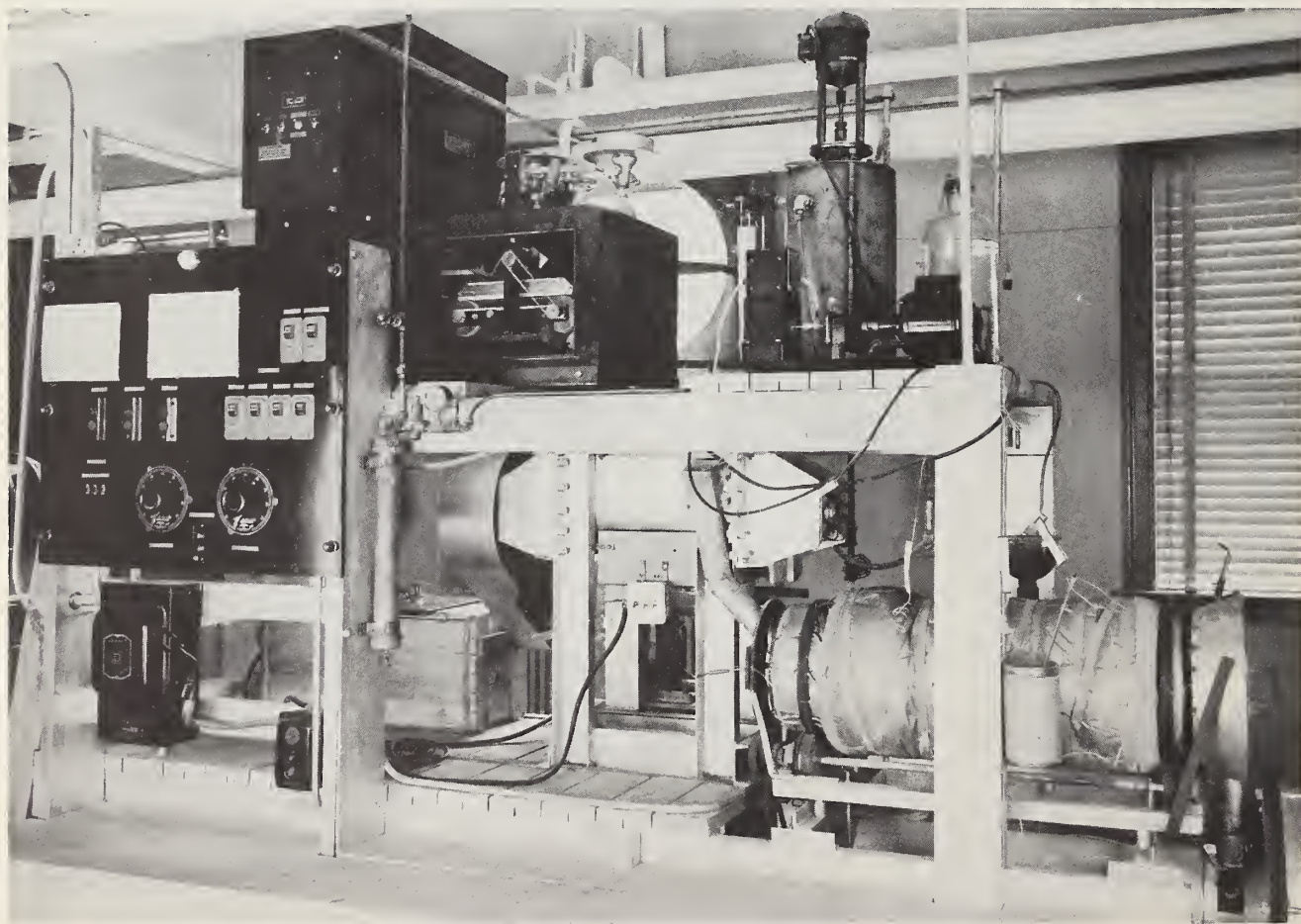
Mineral Nutrition Laboratory

This laboratory does pioneering research in the field of plant nutrition. Its scientists are studying the processes by which plants take up nutrients, how the nutrients function in plants, and how mineral nutrition is related to the environment of the plant and the complex process of growth. The purpose of the laboratory is to develop a better understanding of life processes in plants, especially the role of mineral nutrients. Laboratory findings provide a scientific basis for workers to use in attacking the practical problems of soil fertility and crop production.

Fertilizers and Agricultural Lime

The composition and manufacture of nitrogen, phosphate, and potash fertilizers, liming materials, and soil amendments and ways to make them more efficient and more widely available are being studied in laboratories and greenhouses by the Fertilizer Investigations Research Branch. The Branch also seeks to improve the manufacture, packaging, and storage properties of higher analysis mixed fertilizers.

Methods and standards for analyzing fertilizers and liming materials are developed cooperatively, and data on resources, supplies, production, and consumption of such materials are gathered. These studies point up such developments as the increasing use of granular fertilizers.



Continuous small-scale granulation plant for preparation of improved fertilizer.

9742-D

AGRICULTURAL MARKETING SERVICE

Grain Standardization

The Agricultural Marketing Service (AMS) maintains offices and laboratories at the Agricultural Research Center to conduct investigations on grain standards. Before the formulation of Federal grain standards, grain marketing was in a chaotic condition. There was a wide variety of local standards and no uniformity in their application. Federal grain standards now provide a common, understandable language between buyers and sellers. Official inspection gives an unbiased appraisal of the quality and condition of grain, independent of the buyer or seller.

To supply background information for the inspection of grain, the Standardization and Testing Branch of the Grain Division performs mechanical and chemical tests on most grains and in addition milling and baking tests on wheat. The purpose is to improve the standards to meet changing conditions and to work out new and improved methods of evaluation that can be translated into terms of practical inspection service. Standardization studies are also made on rice, peas, beans, hay, and straw.

Mechanical grain-inspection equipment has been developed and standardized to eliminate the personal element. This equipment includes a divider that cuts down large samples into aliquot portions for analysis, an improved test-weight-per-bushel apparatus, standard dockage machines, sieving apparatus for kernel-sizing tests, and rice-shelling and milling devices for determining the milling quality of rough rice.

Testing Miscellaneous Commodities

The AMS Grain Division is responsible for inspecting and testing a wide variety of commodities, including flour, cereals, other grain products, vegetable

oils, vitamin products, soaps, and many other commodities. Much of this testing is done at the Center, but some of it is done by commercial and other laboratories under the supervision of the Grain Division laboratories at the Center.

Insuring Seed Quality

Congress passed the Federal Seed Act in 1939, which is enforced by AMS. It requires complete and truthful labeling of seed shipped in interstate commerce for seeding purposes and prohibits false advertising. It also prohibits the importation of seed that fails to meet certain standards of quality.

To make sure that seedsmen are complying with the law, AMS each year examines hundreds of seed samples taken from interstate trade channels by State inspectors under State seed laws. These seeds are tested at the Federal seed-testing laboratory at the Center and, under the supervision of this laboratory, at field laboratories in California, Missouri, Minnesota, New Jersey, and Alabama.

Germination tests on these samples reveal the viability of seeds in each shipment. The tests are made by placing a specific number of seeds on moist blotting paper or towels or in sand or other soil and letting them remain for several days in a cabinet kept at the temperature best suited for the germination of that particular kind of seed.

Reducing Spoilage of Fruits, Vegetables, and Other Agricultural Products

The Quality Maintenance and Improvement Section of the Market Quality Research Division conducts research on the handling, transportation, and storage of fruits, vegetables, and other agricultural products. This work is done at the Plant Industry Station and at 14 field laboratories in important

producing areas and market centers. A fully equipped cold-storage plant at the Plant Industry Station includes 22 rooms, in which temperature and humidity can be controlled. Studies are made here on the effects of temperature, humidity, growing practices, time of picking, storage atmosphere, packaging, and other factors on the quality of fruits and vegetables and the length of time they can be kept in storage. Research is conducted on the deterioration of grain in storage and on the handling, packaging, and shipping of poultry.

These investigations have yielded many valuable results. The important fruit and vegetable diseases that result in spoilage between the shipping point and the consumer have been studied and identified; they have been described and illustrated in color in a series of market-disease bulletins. The storage life of grapes has been extended for several months by improved fumigation procedures. Green mature tomatoes have been shown to ripen better and decay less at moderate transit and ripening-room temperatures than at the lower temperatures formerly used. Moderate transit temperatures are also found to favor the healing of skinned and cut early potatoes and to prevent decay development. Ventilation has been shown to provide favorable transit temperatures for oranges during parts of the year. All these findings reduce the cost of transit refrigeration by hundreds of thousands of dollars annually and make it possible to deliver better quality produce. Investigations of packages and packaging films have indicated the best ones to use for different kinds of fruits and vegetables and how to use them. By using polyethylene box liners the pear industry gives the consumer a superior product over an extended marketing season. The use of polyethylene lug liners ex-



M-4641

A seed technologist prepares a sample of field pea seeds for a germination test. The device in his left hand automatically counts out the number of seed desired.

tends the market life of sweet cherries and makes possible the use of freight shipments instead of express, with substantial savings in marketing costs.

Quality Evaluation Research

The Quality Evaluation Section of the Market Quality Research Division develops methods and equipment suitable for sampling, inspecting, and grading agricultural commodities. Its research underlies the development of grades and standards for farm products. The headquarters are at the Plant Industry Station (south wing of the Administration Building), but units are also located at the Center (South Lab-

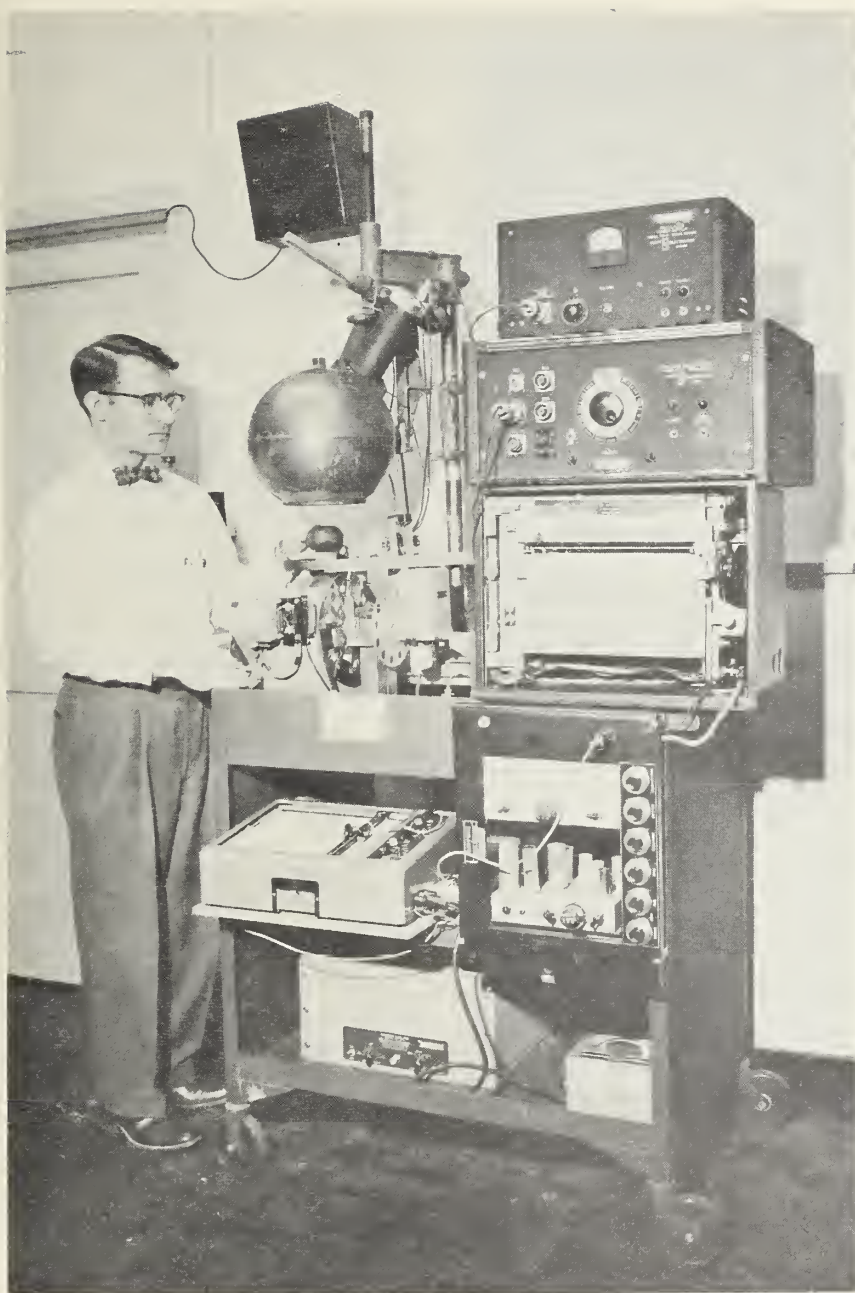
oratory Building) and at three field stations.

This Section serves as the research and development arm of the AMS operating divisions that administer and enforce the statutes, such as the United States Grain Standards Act and Federal Seed Act, authorizing permissive and compulsory grading. Research is performed on all major commodities—poultry, eggs, dairy products, grain, seeds, fruits, vegetables, sugar, molasses, and fibers. The staff includes biological, chemical, and physical scientists and engineers, with chemists and engineers predominating.

The research studies fall into five categories:

1. Sampling and blending, including adequate statistical studies and mechanical aids for sampling, such as automatic samplers. A device has been developed to sample peanuts automatically. It is expected to improve greatly the accuracy of peanut inspection and grading.

2. Measurement of color objectively. An electronic light-transmittance instrument is undergoing tests to provide a new means of evaluating color. It can "look inside" a fruit or vegetable and detect differences in interior color and certain defects.



BN-5124

An engineer measures the interior color of a tomato with a special instrument developed by Department research workers. This instrument records the light-transmittance properties of intact fruits and vegetables.

3. Measurement of rheological properties such as texture, consistency, and visco-elastic properties. A shear press has been devised recently with electronic indicators and recorders for better measurement of maturity and tenderness in vegetables and meats.

4. Methods, tests, and devices for measuring defects, damage, contamination, and deterioration. A technique has been developed for detecting hidden insect infestation in grain.

5. Application of nondestructive physical principles such as ultrasonic, radio-frequency, and microwave energy, X-ray, and fluorescence. This basic research develops new principles for grading intact commodities. Successful application of these principles forms the basis for developing automatic sorting equipment. This research is carried out to the stage of fabricating and testing prototype sorting machines. The commercial blood-spot detector for eggs, based on patents of the Section's engineers, and the green-rot detector for eggs have been developed.

Stored-Product Insects

The Stored-Product Insects Section of the Market Quality Research Division investigates methods for the prevention and control of insects attacking agricultural products in the marketing channels. This Section has its headquarters at the Plant Industry Station. One research project is conducted here in cooperation with the Quality Evaluation Section on the development of an automatic device to detect and evaluate hidden infestation in grain. Such techniques as color reaction, measurement of fluorescence of some byproduct of infestation, measurement of force required to shear infested as compared with uninfested kernels, and measurement of spectral transmittance are studied to see if they can be adapted to instrumentation.

FOREST SERVICE

Beltsville Experimental Forest

This 3,000-acre woodland on the east side of the Agricultural Research Center serves as the headquarters for a research unit of the Northeastern Forest Experiment Station, and as an outdoor laboratory for basic forest physiology research. Here studies are conducted under natural forest conditions, and the responses are closely observed and measured.

The research program aims at the solution of problems pertaining to silvics, forest management, genetics, diseases, and insects of the pine and hardwood forests of the northern Piedmont region. These forests contribute wood products, help conserve water, and provide recreational facilities for more than 7 million people in southeastern Pennsylvania, central Maryland, and northern Virginia.

Silvical studies in light relationships, photosynthesis, nutrition, and vegetative propagation of forest trees provide information on the behavior of species under different conditions. This information helps guide nursery practice and the selection of a species for a particular site.

The forest-management studies stress fundamental relationships in the ecology of the pine forests that cover more than 8 million acres of poor, wornout land in this region. These studies aim to determine the best methods to insure profitable yields of forest products and good regeneration of desirable species under varied environmental conditions.

Major emphasis in the forest-genetics studies is being placed on screening tests of more than 200 hybrid poplars. Many of these trees grow very fast and some show resistance to harmful insects and disease. Hybrids of poplar, ash, soft maple, and pine have been planted in the experimental forest at the Center.

Studies concerned with chestnut blight include experimental plantings of Asiatic chestnut introductions, the irradiation of American chestnut scion

wood for possible mutations, and the determination of the relative disease resistance of large native chestnut trees that have escaped the blight. The prevention of rots attacking subfloor timbers of basementless houses by various soil covers is also being investigated.

Insects are abundant in the pine-hardwood forests of the Piedmont region and, like fire and disease, are factors in the management of the woodland. The biology and ecology of the more important insects and their biological and chemical control are being studied at the field laboratory at the Center and in the surrounding States. The activity of the insects and the losses they cause are surveyed periodically as a part of the insect research program.

Forest Physiology Laboratory

Fundamental knowledge of tree growth is being sought in a tree physiology laboratory established in 1958, under the supervision of the Division of Forest Management Research. The long-range program of research adopted for the laboratory will include the inorganic nutrition of forest trees, the mycorrhizal relationship in trees, the effect of photoperiod and thermoperiod on growth and development, and the absorption, translocation, and site of action of growth-regulating compounds, such as herbicides. Examples of current studies are the foliar absorption of phosphorus and its movement in the tree and the effect of nutrient level on the development of mycorrhizae. Research findings under the controlled conditions of the laboratory form the guide lines for practical experimentation in the woods to improve the growth of trees.

Beltsville Forest Insect Laboratory

The Division of Forest Insect Research, which is responsible for studies of forest, shade-tree, and wood-products insects, has one of its field laboratories at the Center. Three principal lines of work are carried on here:

Research on airplane spraying for controlling forest insects, development of aerial survey methods for determining the extent and severity of infestations in forests, and investigations on the control of termites and powder-post beetles.

Studies on airplane spraying are carried on in cooperation with the Agricultural Engineering Research Division of ARS, and include work on spray equipment for light and transport type of airplanes, and development of formulations specifically designed for aerial application to forests. Both chemical insecticides and biological agents, particularly certain viruses that attack insects but are not harmful to man, are being studied to determine how they can be most efficiently distributed over the forests, and how they can be made most effective against a particular insect species after they reach the foliage. Research on aerial surveys includes development of special devices and techniques, visual and photographic, for identifying and recording from the air various types of insect damage. Airplanes specially equipped as "flying laboratories" are based at the Center airfield for these studies.

Different types of chemical treatments are being tested to determine their long-term effectiveness in protecting wooden buildings and other wood products from termites and powder-post beetles.

Collection of Wood-Rotting Fungi

The Division of Forest Disease Research maintains in the North Building, Plant Industry Station, one of the world's largest collections of living cultures of fungi that cause disease and decay of living forest trees and deterioration of forest products. This rapidly expanding collection, now totaling about 7,000 isolates representing about 600 species of fungi, serves as the basis for the diagnosis of tree diseases and for studies to improve the protection of

wood in transit, storage, and use. In addition, it serves the Nation's mycologists as source material to aid in fungus identification.

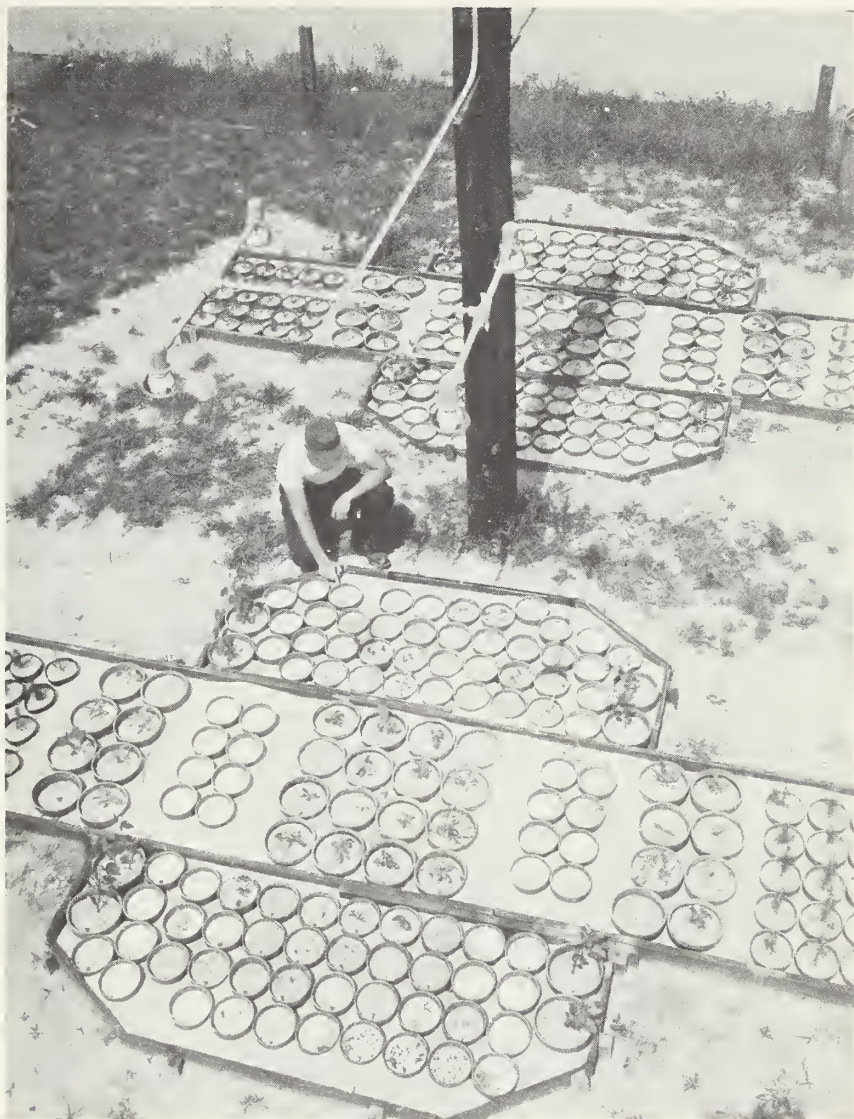
Beltsville Radio Laboratory

This laboratory has long been maintained as the primary center through which the special radio equipment requirements of the Forest Service may be presented to those companies interested in manufacturing to meet service needs. More recently the laboratory has been expanded to provide a similar service in the field of general electronics equipment, particularly as may be proposed for application in fire detection and fire suppression activities.

Laboratory engineers have developed and maintain current the specifications for radio equipment that are used in servicewide procurement contracts. They test for specification compliance samples of all equipment offered by industry for Forest Service use, and they work with industry engineers in developing special modifications necessary to meet particular requirements.

Through frequent contact with Forest Service field people, laboratory engineers consult in the development of radio installation and maintenance standards and in the training of maintenance technicians.

In the field of general electronics, laboratory engineers serve as consultants to foresters in determining the feasibility of new techniques and in the development of specifications for special electronic devices. They also provide a center with which industry may work in developing ideas or equipments to meet particular Forest Service needs.



S-1567

The response of forest tree seedlings to photoperiod is studied under outdoor conditions with natural daylength supplemented with flood lights.

Soil Conservation Service

National Plant-Materials Center

A national observational center collects and tests plants for soil and water conservation and other uses. Because vegetation is fundamental in conservation farming, this center deals with grasses, legumes, and forbs, as well as

trees and shrubs. These may come from the wild, from abroad, or from cooperating research agencies. Attention is given to vegetative characteristics, fruiting habits, simplicity of reproduction, soil-conserving qualities, propagation, seeding, culture, and seed harvesting and processing.

Plants that show superior conservation values are given further tests at field locations and on farms. They are checked by farmers, ranchers, or technicians for farm, range, forest, and wildlife conservation. Once proved, the plants reach farmers and ranchers through regular commercial channels.



N-35158

Layout of National Plant-Materials Center, Soil Conservation Service, at the Agricultural Research Center.

Soil Surveys

In the Soils Building scientists have completed maps of many countries and are working on many others that will be part of a world soil map. A soils laboratory does the more complex analyses in support of soil-survey work throughout the country and performs special studies on different kinds of soils. A group of scientists and editors

in the South Laboratory Building do the final compilation and editing of maps and text of soil-survey reports from all over the country. Soil scientists also work on the classification and correlation of hundreds of different kinds of soils and development of standard descriptions.

The Cartographic Division, headquartered in the North Laboratory

Building, prepares the Soil Survey maps. It maintains facilities for making and reproducing maps, charts, mosaics, aerial and still photographs, and technical drawings. This service unit supplies many of the materials used by technicians and farmers in making overall and detailed plans for applying conservation measures throughout the United States. Because of its location it also provides complete cartographic services for the field offices of the Soil Conservation Service (SCS) in the Northeastern States.

Engineering and Design

The Central Technical Unit of the Engineering Division is located in the Soil Management Building. It develops, improves, and studies the effectiveness of hydrological and geological techniques and procedures that are required in the planning and installation of SCS programs.

The Washington Design Section of the Engineering Division (1) develops standards to be used nationally in preparing plans for conservation structures, (2) prepares standard plans for commonly used structures for the use of field engineers, (3) trains field engineers in specific procedures of layout and design of structure, and (4) prepares technical data and handbook material for use in guiding field operations. This Section is housed in the Cartographic Annex at the Center.

BUREAU OF SPORT FISHERIES AND WILDLIFE, FISH AND WILDLIFE SERVICE OF THE DEPARTMENT OF THE INTERIOR

Closely related to agriculture is the work of the Patuxent Wildlife Research Center, one of the Nation's larger stations for investigating wildlife management problems. This Station, located immediately east of the Agricultural Research Center, is administered by the Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service of the United States Department of the Interior. On its 2,670 acres are lab-

oratories, lakes, forests and farms, all devoted to research on management of wildlife.

The accent at the Station and throughout the Bureau of Sport Fisheries and Wildlife is on finding ways to meet tomorrow's fish and wildlife needs. The Nation's population is expanding explosively—200 million expected by 1970 and 300 million by the turn of the century. In terms of recre-

ation, more people mean greater needs and larger demands on fish and wildlife resources. Surveys in 1955 showed that 20,830,000 Americans over the age of 12 pursued fishing as a recreation. The same year, 11,784,000 Americans over 12 participated in the hunting of game. With sharp population increases on the way, less land and natural water areas will be available in the future to produce much sought-

after fish and game. Through better land-use planning and research this threat of shrinking natural habitat is being challenged.

At the Wildlife Research Center, land use in relation to wildlife production is a major subject of investigation. The effects of farm practices on wildlife populations are studied and better methods of coordinating wildlife management and modern farming are tested. Three experimental farm areas are developed along contrasting lines, one by the traditional clean-fence-row method, a second according to modern soil conservation practices, and a third by a combination of soil conservation farming methods and other new techniques.

Striking differences were demonstrated in the small game populations of these areas during the 1958 hunting season, when 5 rabbits were shot on the clean farm of 87 acres, 25 on the conservation farm of 170 acres, and 36 on the combination farm of 160 acres. During that same year the fall populations of bob-white quail on these contrasting areas were 20, 84, and 60 respectively.

Creation and effective management of waterfowl habitats are being demonstrated on nearly a score of Wildlife

Research Center impoundments, most of them established in former swamps, gravel pits, or similar waste areas such as occur on many farms. Water-level management, including use of alternating summer drawdowns in dark-stained-acid waters, is being emphasized as a means of increasing supplies of natural waterfowl foods. On approximately 160 acres of such developed water areas, up to 3,000 migratory waterfowl have found suitable environment for a major part of the winter where no waterfowl previously existed. In 1959, at least 66 waterfowl broods, totaling 415 young, were produced on this impounded acreage. Included in this production were wood ducks, mallards, Canada geese, black ducks, and pied-billed grebes.

The Wildlife Research Center is the headquarters and nerve center for all banding of migratory birds on the Continent, and for national recordkeeping on bird distribution and for statistical analysis of population data. More than 1,500 qualified volunteer ornithologists in Canada and the United States cooperate with the Center in banding and distribution studies.

Diagnostic work and research on diseases and parasites of wildlife are an

important part of the Station's program. Special attention is being directed to trichomoniasis, a serious protozoan disease of doves and pigeons, to distemper in active carnivores, and to parasites of Canada geese and other waterfowl. An extensive survey is being made of the diseases and parasites of migratory blackbirds to determine whether such knowledge can be used to develop a biological control technique for these birds when and where they do damage to agricultural crops. Other possible methods for controlling the depredations of these birds are being explored at the Center.

Control of pest insects is an essential part of modern agricultural practice, but unfortunately, some of the more effective insecticides are toxic to fish and wildlife. The Wildlife Research Center is conducting research to determine the extent of pesticidal hazards to mammals and birds, and to aid in the development of safer materials and techniques.

Although independent from the Agricultural Research Center in administration, many activities of the Patuxent Wildlife Research Center are closely allied with those of the Agricultural Research Center in contributing to better farm living.

GODDARD SPACE FLIGHT CENTER OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

When the National Aeronautics and Space Administration was formed in late 1958, Congress authorized the creation of a new research center. The new center, to be called the Goddard Space Flight Center, is to house a reservoir of skilled manpower to assist in the national program of space flight development and to provide facilities

sorely needed for space science research. This Center is a part of the new civilian space agency that includes other centers formerly under the National Advisory Committee for Aeronautics.

The Goddard Space Flight Center is presently under construction on grounds formerly a part of the Agricultural Research Center. When the

Space Flight Center is completed, it will consist of six major buildings for housing the required technical, administrative, and shop personnel. Although construction has just started (1959), more than 1,000 people are now employed and working on space projects that will be housed later at the Goddard Space Flight Center.



Air view of Plant Industry Station. Five acres of greenhouses in foreground.

